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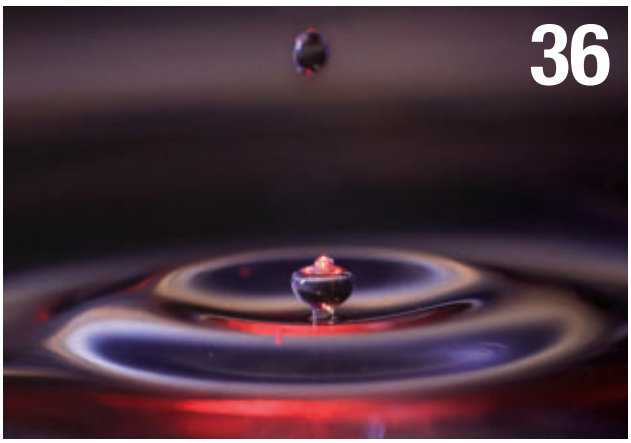

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Perfumer & Flavorist has compiled a first of its kind digital directory of F&F industry providers including agencies, consultants, certifiers, toll manufacturers and more. See the full list of companies on page DM1

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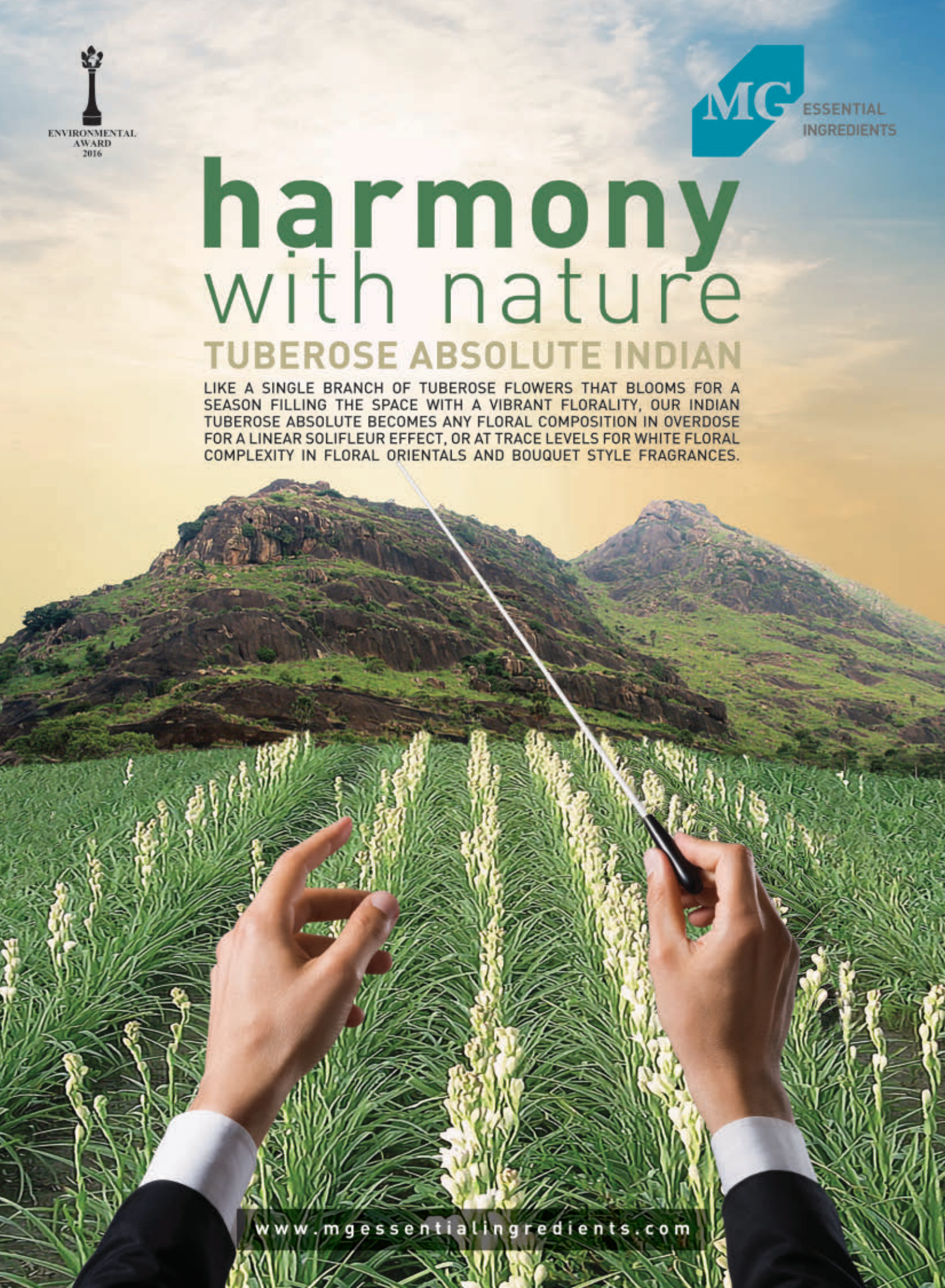

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Behind the Scenes

As a big fan of cinema, I always look forward to the Academy Awards. Not just for the social purposes (who doesn't love a good Oscars party?), but also for the chance to celebrate the craft—particularly the craft categories, such as the awards for cinematography, costume design and editing.

These elements are, in a way, the unsung heroes of the medium, providing the foundation that supports the writers, directors and actors who often get far more attention. And the same, I think, could be said about lab equipment and packaging. While the flavors and scents might take center stage, it would be impossible for consumers to enjoy them without the machinery and innovations that take them from the lab to the shelf.

In our March issue, we shine a light on this segment of the industry. The team at Colgate-Palmolive offers insights on creating packaging that delivers on every front—sustainability, safety and aesthetics—while maintaining the integrity of the flavor (page 40). Within the lab, professionals from Erlab and MilliporeSigma advise on ductless hoods and water purification systems (pages 24 and 36, respectively), while Beta Analytics takes us through the process of testing biobased and natural ingredients (page 30).

Also in the issue: Paul Kiler talks about expanding the olfactive horizon with Schiff Bases (page 18), and associate editor Alex Mackenzie explores whether or not recent legislation spells the end for vaping, and how that impacts the flavor industry (page 48).

So please, join us in celebrating the people, things and ideas that sometimes go unsung. We hope you enjoy the issue.

Best regards,

Eden Stuart

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Natural Advantage introduces Natural S-Allyl Cysteine (FEMA# 4322, CAS# 21593-77-1). S-Allyl Cysteine is found in both garlic and onion. This material portrays a cooked, roasted profile that makes it useful for onion, meat and garlic flavors. While having strong garlic characteristics, this compound is also very useful for achieving kokumi notes. It is EU and U.S. natural, kosher, non-GMO and has a recommended use level of 1-20ppm.

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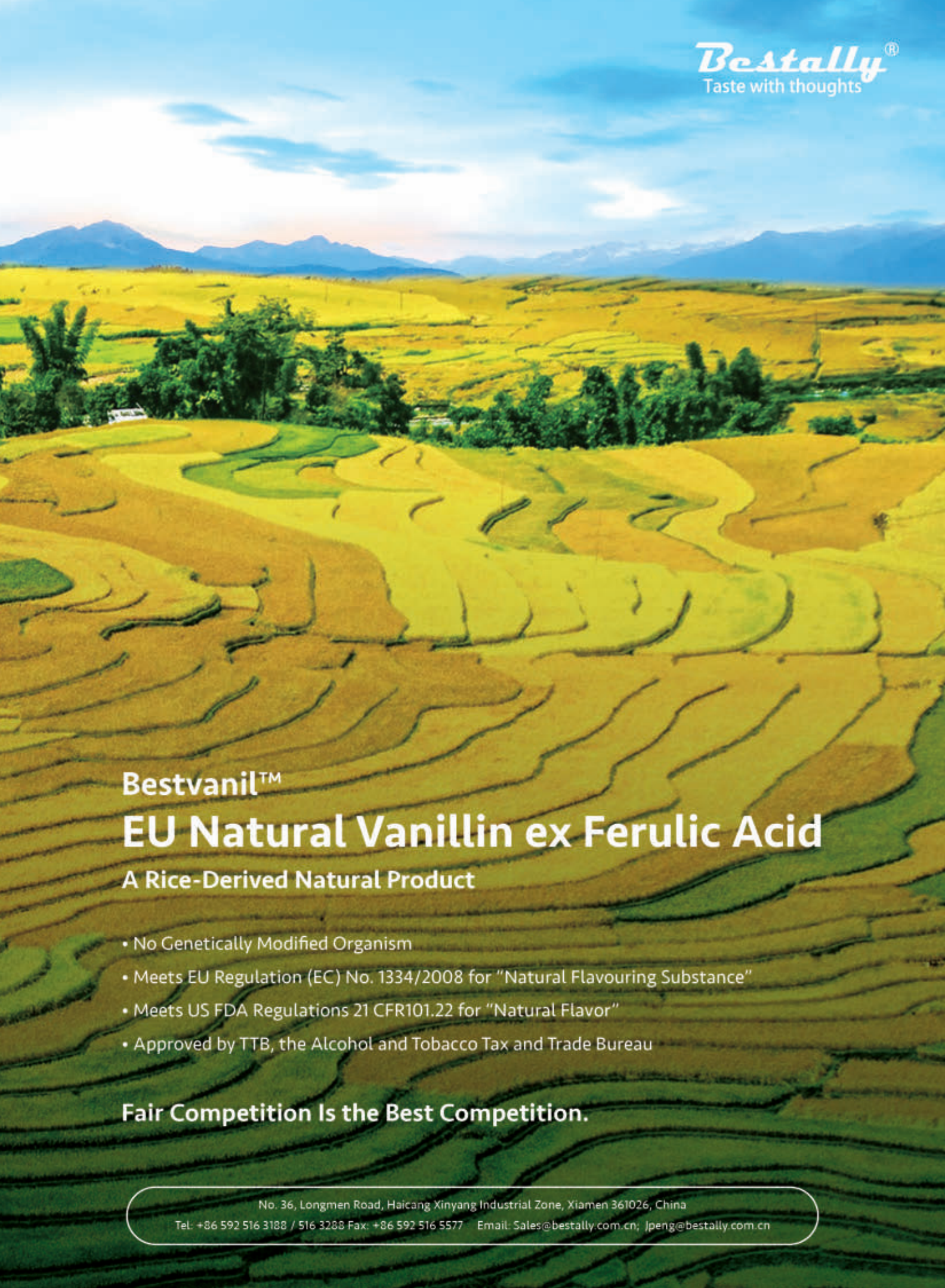
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Notification of the IFRA 49th Amendment

The 49th Amendment adds a further 25 Standards bringing the total to 216.

The International Fragrance Association (IFRA), the global body representing fragrance ingredient manufacturers and compounders, has published an update to its flagship fragrance safe use program, the IFRA Standards. The IFRA Standards set maximum use levels on certain fragrances in finished consumer goods products based on scientific research into potential health and environmental effects.

"The IFRA Standards is the industry's flagship program for the safe use of fragrance ingredients. The Standards set rigorous, comprehensive and global rules based on scientific evidence and consumer insights and are subject to independent oversight," said IFRA President Martina Bianchini.

The Standards—which also set purity rules or may ban certain ingredients for fragrance applications—are derived from scientific assessments by the Research Institute for Fragrance Materials (RIFM) with independent oversight by the Expert Panel for Fragrance Safety. The latest update represents the most significant change to the Standards in years.

Due to new methodologies and the new procedure to set Standards being developed/implemented for the first time, the 49th Amendment's preparation has been challenging, according to the organization. The updated Standards are derived from a new safety assessment approach, include rules based on overall consumer use of fragranced products, and feature new and revised product categories. The number of Standards has therefore increased by 25, totaling 216. There are also changes to 91 existing Standards.

"We want consumers to continue to enjoy fragranced products with confidence. The IFRA Standards are our contribution to setting an industry-wide global framework and guidance for every manufacturer and compounder to follow. This boosts transparency while ensuring there is space for creativity and innovation."

The new Standards for dermal sensitization are based on a new assessment methodology, known as Quantitative Risk Assessment (QRA2), which has been developed through a multi-stakeholder process involving dermatologists, academics, the industry and other stakeholders. The platform for this development was the International Dialogue on the Evaluation of Allergens (IDEA).

The new Standards look at aggregate exposure of fragrance ingredients via different consumer products, using a database of real-life product use and habits that feeds into a statistical model, helping the organization to understand how people use

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fragrance products in everyday life and to set rules that ensure they can continue to use them safely.

Because new methodologies are being introduced as part of the 49th Amendment—due to QRA2, which has led to new IFRA Standard Categories, among other changes—IFRA has taken decision to grant a prolonged implementation timeline for all Standards within the scope of the 49th Amendment.

IFRA Standards prohibiting or restricting the use of ingredients

Date for Standards entering into force for new creations

Six months after the completion of the information exchange across the supply chain period (which is seven months after the Notification date). In total, this is 13 months after the date of the Notification (i.e. February 10, 2021).

Date for Standards entering into force for existing creations

18 months after the completion of the information exchange across the supply chain period (which is seven months after the Notification date). In total, this is 25 months after the date of the Notification (i.e. February 10, 2022).

IFRA Standards introducing a specification on the use of a fragrance ingredient

Date for Standards entering into force for new creations

Exceptionally for the 49th Amendment there is no difference of timeline for Specification Standards. Therefore, the timeline for Specification Standards is also 13 months after the date of the letter of Notification (i.e. February 10, 2021).

Date for Standards entering into force for existing creations

Exceptionally for the 49th Amendment there is no difference of timeline for Specification Standards. Therefore, the timeline for Specification Standards is also 25 months after the date of the letter of Notification (i.e. February 10, 2022).

IFRA will continue to offer education, training and implementation support to members, consumer goods companies and other stakeholders to ensure correct application of the Standards. While the Standards are compulsory for IFRA members, non-members are encouraged to follow the Standards as a way of promoting the safe use of fragrance as well as maintaining and enhancing consumer confidence in fragrance.

Citromax's Organic Lemon Groves to Reach 110,000 Trees

Citromax Group has announced it's surpassed the 100,000-tree mark at its organic lemon groves and is now approaching 110,000 organic lemon trees, an achievement that validates the company's standing as the largest organic lemon producer in the world.

The groves, which are located in the foothills of the Andes, providing a unique sub-tropical climate, produce premium organic lemons with a high juice content. The three groves, known as Rosa, which is the oldest and largest, Rincon and Victoria, are situated on more than 860 acres.

In 2004, the company's processing plant in Tucumán, Argentina, was certified as an approved organic processing facility. Citromax continues to focus its organic lemon operation on the health and wellness market and its portfolio includes essential lemon oils, lemon juice concentrate, not-from-concentrate lemon juice and lemon pulp cells.

The company's organic folded lemon oils, lemon extracts and flavors can be used in 100% organic and national organic program (NOP)-compliant products, as well as in support of the growing market trend in the health and wellness segment.

Citromax Flavors is a USDA organic and kosher and allergen-free flavor house. Since 2005, it has been formulating organic, NOP-compliant and non-GMO flavors.

Citromax is currently the largest organic lemon producer in the world.

"Citromax Group recognizes the increased global demand for organic fruit products, so we continue to invest in our organic groves," said Mariano Sangronis, commercial manager and head of fresh division. "As the world's largest organic lemon grower and processor, we now produce over 1,000 MT of high-quality organic lemon juice concentrate through sustainable production practices."

Firmenich, Jasmine Concrete & BVLGARI Collaborate on 'Flower Gems of India' Initiative

Firmenich and its local partner Jasmine Concrete have collaborated with Roman jeweler BVLGARI to invest in the "Flower Gems of India" initiative, a flower farming project thats pilot will create a new jasmine farming model for 100 family-owned farms in two regions of the Indian floricultural area of Tamil Nadu.

The project is being developed over three years between 2019 and 2021. The initiative offers farmers an alternative approach to jasmine production: one that improves farmer's profits and quality of the flowers, and leverages permaculture principles like soil restoration and water supply management to establish a farming model that will be sustainable for future generations.

The collaborative initiative is providing farmers with an alternative approach to jasmine production.

Product quality is expected to improve due to a clean and short supply chain, richer organic cultivation, contamination-free farmlands and unprecedented care for each season's harvest. The project is also committed to improving the social and economic wellbeing of these communities with a fixed price and reduced production costs.

BVLGARI's values of sustainability, innovation and care for local communities made Flower Gems of India a natural fit for the company and represents its commitment to the highest standards of ethics in sourcing and production.

Now, with the launch of Flower Gems of India, BVLGARI is working at a fundamental level to secure a sustainable future for multiple generations of traditional craftsmen and family farms—and is displaying its commitment to the social and economic wellbeing of its stakeholder communities.

As BVLGARI looks toward the future and weighs its path forward in a rapidly evolving and increasingly global world, it adds a new facet to its long-term strategy for success: fostering sustainable, ethical and responsible practices in every aspect of its business.

"BVLGARI's quest for the most beautiful and flawless gems of nature lead us to Firmenich and its partner Jasmine Concrete, which produces the world's highest quality jasmine," BVLGARI CEO Jean-Christophe Babin said. "It became important to us to contribute to support the communities that enable us to create our masterpiece fragrances and that we establish a sustainable approach to preserve and support the local economy. Like our jewels, our fragrances are crafted from nature's finest gems, and it is our passion to research, source and, wherever possible, support the production of these extraordinary ingredients."

"Over the last decade, Firmenich has built the industry's leading natural sourcing program to develop sustainable economies, preserve biodiversity and support regenerative agriculture," said Dominique Roques, vice president, naturals, partnerships and communication, Firmenich. "Our NaturalsTogether™ partners like Jasmine Concrete create real change in their communities by implementing advanced flower cultivation, treating issues such as erosion, nutrient loss, irrigation and composting. We are very proud to be a part of this program."

"This agreement, jointly governed by BVLGARI, Firmenich and Jasmine Concrete, provides an innovative model to uplift our local communities," Jasmine Concrete director Raja Palaniswamy. "Our shared business-for-good approach, which builds market security, delivers fixed revenues, and fosters a real sense of pride for farming families, secures local families' livelihoods. This encourages them to continue their important work, now and for future generations."

p&f

Givaudan Releases 2019 Full Year Results

Givaudan has released its 2019 full year results, which detail the group's financial performance and show that the delivery of 2020 guidance is fully on track.

The group's full year sales reached 6.2 billion in Swiss francs, up 5.8% on a like-for-like basis and 12.2% in Swiss francs (CHF). Growth was seen across all product segments and geographies, with the key strategic focus areas in Active Beauty, naturals, health and well-being, integrated solutions and local and regional customers delivering strong growth, complemented by recent acquisitions.

Givaudan's success in 2019 puts the group on track to fully deliver on its 2020 strategy.

One such acquisition is that of Ungerer, a U.S. based flavor, fragrance and specialty ingredients company. The agreement was reached on November 8, 2019, and the completion of the transaction is expected within Q1 of 2020.

"Our excellent performance in 2019 demonstrates the strength of our business and our ability to consistently deliver industry-leading financial results, whilst also implementing our key strategic initiatives," said CEO Gilles Andrier. "I am very pleased with the results we have achieved in 2019 and feel confident that we will deliver against all of the strategic objectives that we defined under our 2020 strategy."

The company's EBITDA increased 11.4% over 2018 to 1,275 million CHF while the group's net income reached 702 million CHF up 6.0%. Operating cash flow increased 24.0% to 1,136 million CHF and free cash flow increased 11.9% to 787 million CHF, coming in at 12.7% of sales.

The proposed dividend for shareholders increased by 3.3% year-on-year to 62 CHF per share. This is the 19th consecutive dividend increase since Givaudan's listing at the Swiss stock exchange in 2000.

The fragrance division saw an increase in sales of 7.3% on a like-for-like basis, and 10.9% in Swiss francs, to 2,799 million CHF. Sales growth was driven by new wins and price increases aimed at recovering the impact of elevated input costs.

The flavor division reached 3,404 million CHF in sales, up 4.5% on a like-for-like basis and 13.4% in Swiss francs. The sales performance owes its success to new wins and strong business momentum across all regions. The 2020 strategy features key strategic focus areas in health and well-being, which grew at double-digit levels, and naturals. Beverages, savory, snacks and sweet goods were the main segment contributors to the growth of the flavor division.

p&f

BY JOHN WRIGHT
johnwrightflavorist@gmail.com

Flavor Bites: Ethyl levulinate

The fruity note of this ester has extra depth and succulence not found in ethyl pentanoate.

Ethyl levulinate (ethyl 4-oxo pentanoate), FEMA GRAS # 2442, CAS # 539-88-8, has an attractive fruity odor. This would be expected from its relationship with ethyl pentanoate, but the fruity note of this ester has extra depth and succulence that ethyl pentanoate lacks. In addition, the keto group gives ethyl levulinate far greater polarity and, consequently, better water solubility. This makes it an advantageous ingredient where flavor components partition between fat and aqueous phases, such as ice cream.

Note that the dose rates given throughout this article are the levels suggested for use in flavors intended to be dosed at 0.05% in ready-to-drink beverages or in a simple bouillon.

Berry Fruit Flavors

Blackberry: Blackberry flavors often restrict the contribution of esters to predominantly berry notes such as benzyl acetate. Five hundred ppm of ethyl levulinate serves to deepen the character without weakening the berry notes.

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Blackcurrant: Authentic blackcurrant flavors gain mouth watering juicy character from the addition of ethyl levulinate. Around 150 ppm is ideal.

Blueberry: Fruity notes that fit naturally into blueberry flavors tend to be light and insubstantial. Ethyl levulinate provides a perfect counterbalance and deepens the taste. Eight hundred ppm is a reasonable starting point.

Cherry: As was the case with blackcurrant flavors, the benefits of this ingredient are more obvious in authentic style flavors. Five hundred ppm of ethyl levulinate works well.

Raspberry: Raspberry flavors are often structured similarly to blackberry flavors and they derive the same benefits from the addition of 500 ppm of ethyl levulinate.

Strawberry: Esters play a much more significant role in strawberry flavors and a hint of this ingredient is all that is needed to add depth. One hundred ppm is a perfect level.

Tropical Fruit Flavors

Mango: Succulence is automatically associated with most tropical fruit flavors. One hundred ppm of ethyl levulinate adds a subtle touch of succulence to mango flavors.

Melon: Melon flavors vary considerably in profile, but many of them can seem overly reliant on light banana related esters such as isobutyl acetate. Ethyl levulinate rebalances the top notes and can be used at quite high levels. One thousand ppm is a good place to start.

Passionfruit: Here, ethyl levulinate provides a good counterbalancing effect to the dominant ethyl esters at levels in the region of 500 ppm.

Pineapple: The same comments also apply to pineapple flavors, especially fresh profile flavors, but the best level of addition is a little lower, nearer 200 ppm.

Other Fruit Flavors

Apricot: Ethyl levulinate adds succulence and fresh fruit character to apricot flavors at around 300 ppm.

Peach: The effect in peach flavors is very similar and works best in fresh profile flavors. Two hundred ppm is a good level to start with.

JOHN WRIGHT'S FLAVOR CREATION,
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FLAVOR CREATION
JOHN WRIGHT

Grape: This ingredient is equally effective in all of the different types of grape flavors, ranging from Concord to Muscat. The best level depends on the other ingredients, but start with 50 ppm and work upwards.

Brown Flavors

Caramel: This ester lacks obvious brown notes; nevertheless, it is more compatible with brown flavors than most fruity esters. One hundred ppm works well in caramel flavors.

Chocolate and cocoa: Three hundred ppm of ethyl levulinate works equally well in cocoa, dark and milk chocolate flavors, a reflection of the fact that this ingredient also has an interesting effect in dairy flavors.

Coffee: Much lower levels, nearer 20 ppm, are excellent in coffee flavors, adding a hint of freshly brewed character.

Maple: The effect of ethyl levulinate in maple flavors is not dissimilar to the effect in caramel flavors. One hundred ppm works well in the popular synthetic styles, but 40 ppm gives a more authentic effect.

Molasses and brown sugar: One hundred ppm also generates a good effect in brown sugar and molasses flavors.

Soy sauce: Good soy sauce presents a smorgasbord of different sensory effects and ethyl levulinate helps to round out that effect at 50 ppm in soy sauce flavors.

Vanilla: Ethyl levulinate is very effective in vanilla bean flavors, giving something of the effect of a nicely aged alcoholic extract at 100 ppm.

Alcoholic flavors

Brandy: This ingredient gives a very attractive effect in brandy flavors at levels in the region of 300 ppm, adding depth and subtlety.

Dark beer: Realistic beer flavors represent quite a challenge to the flavorist, and any help is welcome. Ethyl levulinate has a subtle, but useful, effect at around 20 ppm, working especially well in dark beer flavors.

Rum: The best level in rum flavors depends, as usual, on the type of rum. Fifty ppm is a reasonable place to start but some dark rum styles can take double this level.

Whisky: Fifty ppm is also a good starting point when adding ethyl levulinate to whisky flavors.

Wine: Ethyl levulinate is equally effective in red and white wine flavors, giving both extra depth and a hint of bottle age at 50 ppm.

Nut Flavors

Hazelnut: The role of ethyl levulinate in nut flavors is distinctly secondary, but it does help to round out and add depth to a category of flavors that can easily be too bright. Thirty ppm is a reasonable level of addition in hazelnut flavors.

Peanut: Peanut flavors are better served by a slightly higher level, in the region of 50 ppm, but the effect is similar.

Walnut: Just a hint, around 20 ppm, of this chemical has an attractive softening effect in walnut flavors.

Other Flavors

Bacon: Ethyl levulinate might seem a surprising ingredient for a bacon flavor, but quite high levels, around 500 ppm, have a very pleasant rounding effect, softening the brighter smoke and bacon notes.

Butter: A hint, 20 ppm, of ethyl levulinate softens authentic style butter flavors. The high level of solubility in the aqueous phase is especially helpful in this application.

Chicken: All styles of cooked chicken flavors, from BBQ to boiled, derive a level of added realism from around 50 ppm of this ingredient.

Cream: Ethyl levulinate has a similarly useful effect in cream and milk flavors to that in butter flavors. Twenty ppm is, again, an ideal level.

Tomato: The effect of this ingredient in fresh tomato flavors is to add succulence and tone down the tomato leaf thiazole notes. Two hundred ppm is a good starting point.

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SCHIFF BASE SHUFFLING: PAUL KILER'S NEW WORK WITH OLD CHEMISTRY

The California-based perfumer's experiments allow him to play with scent structures—and expectations.

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BY EDDIE BULLIQI, independent journalist

New perfumery molecules are being put under greater scrutiny by the F&F industry than ever before, not only on the regulatory side, but also by today's consumer, whose cultural codes are dictated to a greater and greater degree by naturals and naturality. Combine that with a mythologized distrust for synthetics and stunted space for the discovery of new synthetics (versus the 1970s, when the novelty of aroma chemicals was virgin territory), and you have a significantly discouraging drag wind for scent chemists.

Self-taught independent perfumer Paul Kiler, winner of the Aftel Award for Handmade Perfume at the 2019 Art and Olfaction Awards, is taking an alternative path with both his perfumery and chemistry. The California-based Kiler's experiments with Schiff bases are allowing him to play with scent structures and expectations in innovative ways using these super-heavy, high-performing molecules.

This interview reviews how Kiler is using Schiff bases in his perfumes and what he hopes to discover with further experiments.

Award winning, independent perfumer Paul Kiler.

Eddie Bulliqi [EB]: How did you first come to perfumery and what did you set out to achieve?

Paul Kiler [PK]: In rebellion to the 1990s men's "sports" fragrances that all gave me a headache, I just wanted to make a scent that I could wear and not have an adverse reaction to. The one fragrance at the time touted as great was Joop Homme, which was also awful to me. Basically, I hated all the popular men's scents from the 1990s and was looking for something for myself that was a full and orchestral composition with ingredients that I liked. I wanted to try to do something myself that was better than what I found on the market.

EB: What assets do you think the self-taught perfumer brings to composing versus those of the house-taught tradition?

PK: I've never apprenticed nor worked in a fragrance house outside of my own, and I've hardly even taken any perfumery classes—just nine hours in Los Angeles. So, I really can't exactly say what I would possess now had I been through the traditional format of the profession. But I will say that I think that what my self-taught education has placed in me is a freedom to follow my own heart, with both successes and failures. My suspicion is that house-taught perfumers will follow a path that relies more on past successes and copies/variations of current scents, likely a more formulaic style of perfumery than what I find myself doing. I really hate clones; I'd much rather do something of a flanker style but still prefer to make a client an original scent.

Another big difference is that I am just a one-man band here, which has its own strengths and a whole lot of weaknesses. As an artist, coming from many mediums before perfumery, I can adopt a working style that I know works really well for me, instead of being molded into the image of someone/something else.

EB: You are becoming increasingly known for working with your unique self-made Schiff bases. Could you start by explaining what they are and why they interest you?

PK: Schiff bases have very technical definitions, but, in this case, I'll make it pretty simple: a Schiff base is a new molecule made when two molecules combine and then kick out a water molecule. Most commonly, a Schiff base starts with an anthranilate and an aldehyde, but other combinations are possible with other molecule types. The most oft-used Schiff base is aurantiol, made with methyl anthranilate and hydroxycitronellal. A lot of times, the new molecule is strongly colored, which is likely why Philip Kraft tells me that they have fallen out of favor in perfumery.

"I was fascinated that I could make new molecules from these two disparate starting molecules, and that the new combination was different while still retaining aspects of both original molecules."

Schiff bases interest me because they can be very strongly odored molecules — you may only need to use a small amount of one to get great effects and they're usually quite large and long-living molecules.

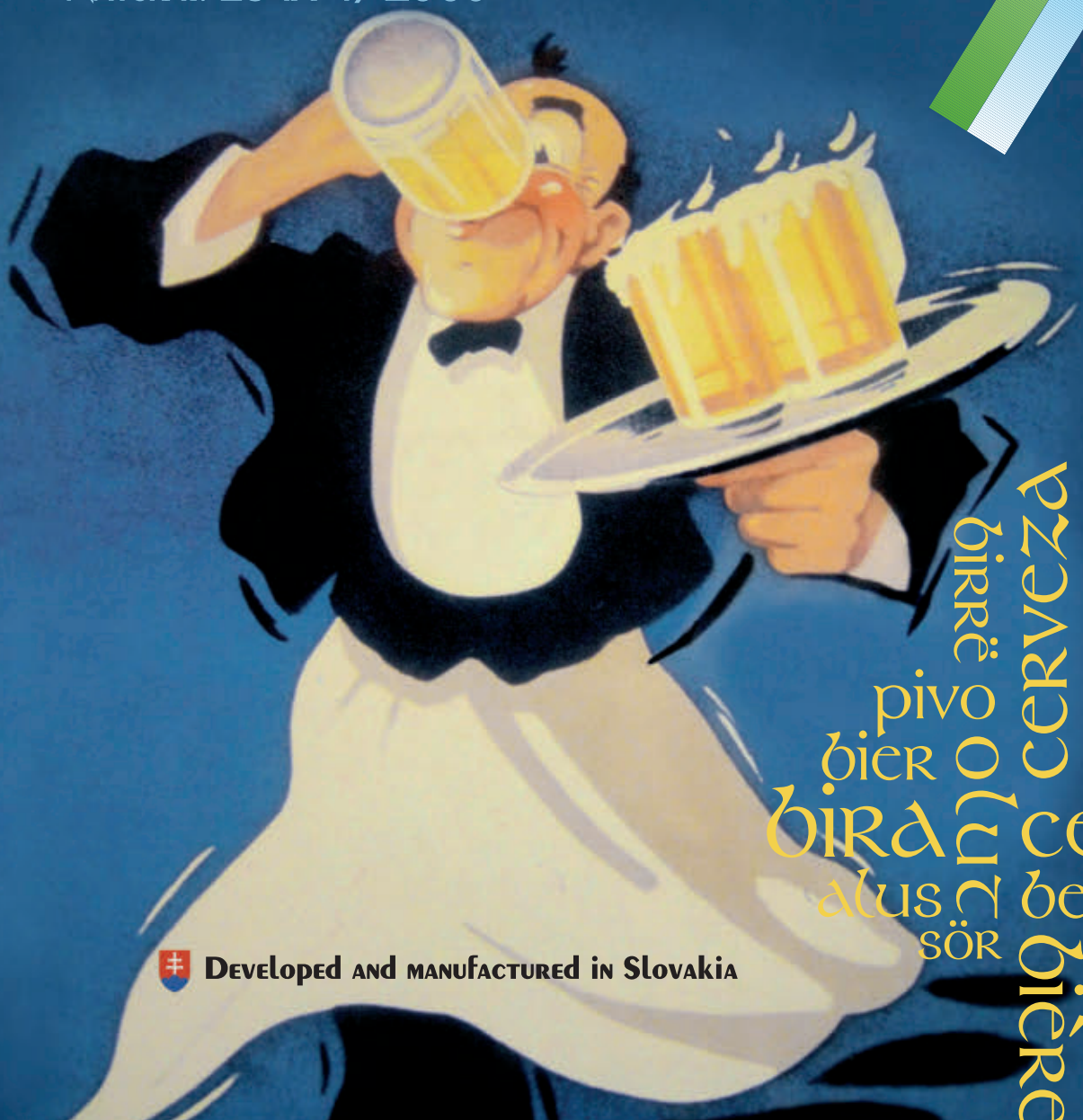
EB: When and why did you start experimenting with your own Schiff bases? Were you initially approaching it more from a technical performance or olfactory hedonic standpoint?

PK: I must have started learning about Schiff bases about 2009. I was fascinated that I could make new molecules from these two disparate starting molecules, and that the new combination was different while still retaining aspects of both original molecules. I had found an absolute dearth of pertinent context; I think that in all of my perfumery chemistry resources I only came up with maybe 10 pages of information. So, I embarked upon my own path of education and experimentation to broaden the number of materials available to me in my works and, essentially, to make my own captives.

EB: Schiff bases have been long-present in commercial composition. How are your experiments different from what came before and how do they represent innovation?

NATURAL
PRENYL MERCAPTAN
NATURAL PRENYLTHIOL

FEMA 3896
CAS 5287-45-6
Natural: EU 1334/2008



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PK: In many aspects they are not different, but, today, Schiff bases are not as prevalent as they used to be. Obviously, I am not aware of big companies' experiments to state definitively here about their development. I think the difference is that I am not really constrained by a raw materials budget and can possibly experiment with more expensive materials than large houses would want to due to time-consuming small yields.

EB: Can you produce entirely new smells with your method, or you focus mainly on extending the life of volatile notes? Any examples?

PK: I am both able to produce entirely new smells and extend the life of more volatile notes. So many people have lamented that a lemon note can only last for a very short time. Through my experiments, I've made a lemony type molecule that lasts five weeks on a strip, and I use that in my 'Long-Lasting Lemon' base, that lasts three weeks on a strip. I'm also looking for new options for green in the base notes instead of using lilial and lyral types.

EB: How many of your experiments have resulted in something you deemed usable and great and how many have you had to abandon?

PK: So far, after more than 150 bases, there are a lot of interesting discoveries. Maybe about 35 are really great/interesting, and 50 more are fairly useful. I still have a lot more to try out! Combinations of several materials in a reaction are interesting, and Schiff bases made with essential oils also have some utility to explore.

EB: Which of your scents have you used Schiff bases in and why did you use them?

PK: So far, I have kept the number of my bases in perfumes for clients down to a few, but I use them more freely in my own PK Perfumes line. Now that I have started to understand these new materials, I'm using them more and more in my new scents. Some of my perfumes use up to 12 bases, all in small amounts, to shape the perfume in the direction I wish or need it to go. These molecules can be very large; some are over 460 MW and still fairly volatile. I had to come up with a new timeline stratum in the evaporation curve because these last so much longer than traditional base notes. I mark them as the "last notes."

EB: What areas are you targeting in your future chemistry work and what excites you the most about its potential application?

PK: I think that a lot of the attention of Schiff bases centers around what ends up being more in the orange blossom end of Schiff base possibilities. I'm really interested in what I can discover that no one else has made before.

I'll make one last comment to perfumers out there that are less familiar, or unfamiliar, with how Schiff bases form and work, because I've seen some amazing failures when Schiff base formation after bottling was not accounted for. I use Roja Dove's fragrance Creation E/Enigma as a lesson in my Schiff base class that I teach. The perfumer who formulated this fragrance did not account for the Schiff base formation between the methyl anthranilate and the vanillin and/or ethyl vanillin. The result is that the scent gets rather dark brown in color and acquires a root beer note over time; none of which, I'm sure, was intentional. They inadvertently created a Schiff base in the scent that takes place a year or so after bottling. Even though Schiff bases may have fallen out of favor, and not much is taught about them, knowing how to use them, how they form and how to avoid them getting made after bottling are very important for all perfumers to know, understand and utilize.

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Innovation in Lab Energy Efficiency and Environmental Sustainability

Erlab's Jesse Coiro and Ken Crooks make the case for ductless hoods.

BY JESSE COIRO, national sales manager, and Ken Crooks, director—Green Fume Hood Technology, Erlab

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The term "lab efficiency" can mean many things to different people; it all depends upon your point of view. In terms of a flavor and fragrance laboratory, three of the most common interpretations are: energy efficiency, research efficiency and testing efficiency. In all three cases, using filtered, ductless fume hoods and odor control filtration devices will improve lab efficiency.

Energy Efficiency

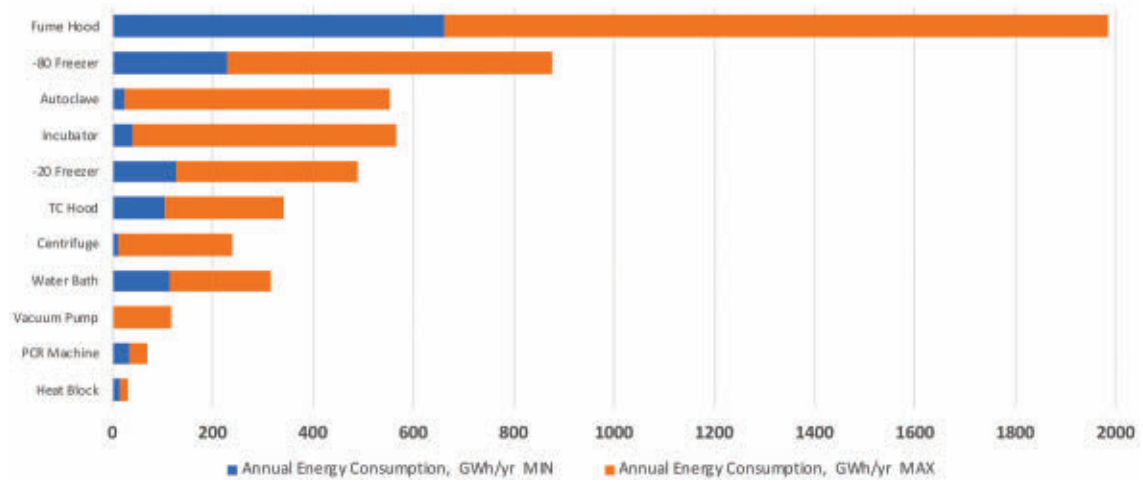
Nothing in a lab consumes more energy than a ducted chemical fume hood. Ducted hoods consume three to six times the amount of energy of a -80°C ULT freezer. For comparison, a 6 ft wide ductless fume hood consumes just 270 watts of power, with the sash open and the fans at full speed. That's just one tenth of one ULT freezer or, looked at another way, 30 to 60 times less power than a typical ducted fume hood (see **F-1**).

If the make-up air demand for the ducted fume hoods in your lab is so great that it exceeds minimum ventilation rates, for at least some periods of time, then the potential exists for reducing the total volume of air being delivered to the lab. That reduction in air volume is where operational cost savings will be generated. Heating, cooling, filtering, dehumidifying and delivering make-up air to labs is very expensive (see **F-2**). In North America, the typical cubic foot per minute (CFM) of fresh air costs between $5.00 and $8.50 per year in energy costs, and a standard, ducted fume hood can consume between 600 and 1,250 CFM of air. This high operational cost of ducted hoods provides ample savings to offset the costs of replacing filters over time with ductless fume hoods.

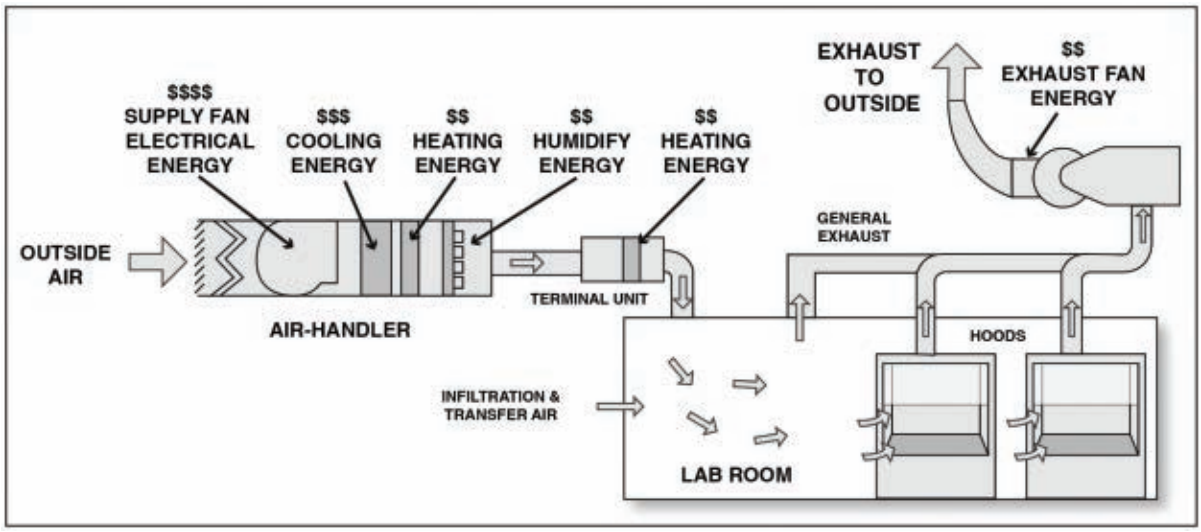
A ducted, chemical fume hood will not function on its own. Ducted hoods require many complex and expensive HVAC systems to be installed in the building so that air is properly extracted from the hood, and tempered make-up air is delivered into the laboratory. Those systems include:

1. Make-up Air Handler Unit (AHU) to temper and supply fresh air to the lab ($$$)

F-1 **Energy consumption per lab equipment, Center for Energy Efficient Labs (CEEL) research/study, 2019**



F-2 **Intensive energy use of HVAC systems for ducted fume hoods (US DOE, 2014)**



F-3 **Cost comparison: Ducted vs. Filtered Fume Hoods (Ellenzweig, 2010)**

Comparison First Cost NC Ducted vs. Filtered	CV	VAV	VAV HP/LF	Filtered
Fume Hood, 6Ft, Vertical Sash [1,2]	$10,000	$10,000	$12,000	$25,000
Building Infrastructure: M-E-P, Lab Services & Data [0,3]	$20,000	$25,000	$25,000	$2,000
Total First Costs	**$30,000**	**$35,000**	**$37,000**	**$27,000**
Energy Costs/Year				
Exhaust Fans[4]	$1,367	$911	$711	$293
Make-up Air ($5/cfm) [5]	$6,000	$4,000	$3,120	$0
Maintenance Costs/Year	$1,200	$1,500	$1,500	$1,800
Total Operating & Maintenance/Year	**$8,567**	**$6,411**	**$5,331**	**$2,093**

2. Hood exhaust fan ($$)
3. Hood exhaust ductwork ($)
4. Hood exhaust airflow control valve and associated controls ($$)
5. Supply air ductwork and insulation ($$)
6. Supply air control valve ($$)
7. Penthouse or mechanical room space for all of the HVAC systems ($)
8. The costs associated with longer construction schedules and delayed occupancy that must be considered when using ducted hoods. ($$ - $$$$)

Ductless hoods, on the other hand, are unitary pieces of equipment that do not require any of these complex HVAC systems. Therefore, when using ductless hoods, many of the HVAC items listed above are eliminated and those remaining can be downsized significantly. Also, the construction schedule can be shortened due to the simplicity of installing ductless hoods.

Independent architects and engineers have determined that the HVAC systems required to make a ducted hood function cost between $20,000 and $25,000 USD for each hood (see **F-3**). These costs are in addition to the cost of the hood itself. Each lab project will be unique in many ways, and these costs will differ slightly from project to project; however, there are significant HVAC system costs associated

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with every ducted fume hood that cannot be avoided regardless of the type of ducted hood being used (i.e. from the simple Constant Volume hood to the complex High-Performance fume hood). All ducted hoods require these HVAC systems to make them work properly.

If you are looking to add fume hoods to your lab, or to reduce your lab's operating costs, consider using ductless fume hoods. Contact your preferred ductless hood manufacturer, and a detailed analysis of your specific application will be performed. The results of this risk assessment will include estimated filter life from which you can calculate operating costs and thus energy efficiency.

The Technology and the Effectiveness of the Removal of Odors and Safety Aspects

Even with the significant savings in energy and overall reduction in construction cost, there are still concerns regarding safety and the product's efficiency, leaving some to ask, "is it worth the savings?" It is always important to know the manufacture of the products, their history and level of expertise with molecular and particulate air filtration. In order to do this, you must ask the following questions:

1. Do you have a published chemical listing of what your "filters" are able to retain and if so, does the listing provide the overall retention capacity expressed in grams?
   - This would represent the overall quantity of the chemical which the filter is able to adsorb before there has been detection at the filters exhaust no greater than 1% of the TLV. ***As per the AFNOR NFX 15.211***
2. How are your chemical handlings validated?
   - A chemical questionnaire should be completed by the user and reviewed and validated by a Ph.D. chemist in order to determine the overall efficiency of the filter's life cycle. ***As per the AFNOR NFX 15.211***
3. Will you be provided with an efficiency report of the filter's performance?
   - A detailed report should be provided showing the efficiency of the filter's performance, chemicals that will be detected for breakthrough and filter configuration options. ***As per the AFNOR NFX 15.211***

These are all critical steps to ensure you are choosing the right manufacturer and have 100% confidence that your safety will never be compromised.

Products Efficiency

With flexible filtration technology, there are many solutions which can be provided:

- Liquid handling and powder application used within the same hood. No turbulence, due to the even distribution of air flow, allows for precise weighing of up to six decimal points. **(Ductless filtering fume hoods)**
- Removal of any cross contamination within smell and/or taste labs. **(Laboratory–air filtration system)**
- Storage of samples without the odorous emissions released into other areas of the facility. Keeping your samples contained and easily accessible and your facility odor free. **(Filtering storage cabinets)**
- Removal of nuisance odors present within the facility, not having to go home smelling like your chemistry. **(Laboratory–air filtration system)**

All products should work as a complete ecosystem, delivering clean air throughout your entire facility. This is all accomplished without the need for any upgrades to the building's infrastructure or the buildings energy load.

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The Natural ORDER

Though terms such as “biobased” and “natural” resonate with consumers, the high cost of plant-based materials makes biobased ingredients vulnerable to economically motivated adulteration.

BY HALEY GERSHON, marketing manager, Beta Analytic

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Biobased Flavors & Fragrances

"Biobased", "plant-based", "eco-friendly", "natural"—these terms are flooding the marketplace as the consumer mindset is becoming more focused on environmental sustainability. In parallel, environmental enthusiasts are moving away from the use of synthetic, petroleum-derived ingredients, resulting in increased attention to both the terms and ingredients that are listed on product labels.[1]

For over a decade, consumers have familiarized themselves with the use of biobased ingredients within a wide range of products, such as personal care items and packaging materials. More recently, the use of the term biobased is making an appearance in the flavor and fragrance industries.[2]

Understanding Biobased

Throughout time, the definition of "natural" has remained inconsistent, creating a challenge for manufacturers, distributors and consumers to fully understand the term and its meaning when used on product labels.[3] Because of this lack of clear definition, industry stakeholders are opting to use terms such as "biobased" on labels in order to visibly demonstrate the use of plant-based sources.

Biobased is defined as materials that are derived in whole or in part from biomass resources.[4] To further clarify, biomass resources are organic materials that are available on a renewable or recurring basis, such as wood residues, agricultural crop residues, grasses and aquatic plants. Therefore, 100% biobased ingredients are materials that are 100% sourced from plants, animals or microbiological by-products.[5]

Biobased ingredients have been used for a variety of different applications. These include the personal care and cosmetic, packaging, pharmaceutical, biofuel, waste-to-energy and food and beverage sectors. According to one study, the global biobased materials market was valued at approximately $11,000 million in 2017 and is expected to reach about $94,150 million by 2026.[6]

Much of the biobased demand is attributed to production of biofuels.[7] In addition, the use of biobased ingredients is soaring within the cosmetics and packaging industries, where companies can visibly display biobased content through eco-labels, such as the USDA BioPreferred certification.[8]

Increased preference for biobased flavors and fragrances will also contribute to the forecasted market growth.[2] Companies with significant lines of fragrance-heavy products that are certified biobased include Lush, Aromafloria/California Fragrance Co., AVEDA corporation, CyberCanine.com, The Hain Celestial Group, Mundo Botanica, L.L.C, Saffron

Rouge, Inc, Taylor Made Herbs and Aromatherapy, Botanical Skin Works, EcoPlanet, Nature My Body and A Wild Soap Bar.

While a large majority of USDA certified biobased products from these companies are skin care and toiletry items, there are a number of dedicated fragrance products and ingredients, such as Lush's Ginger Perfume, a calming mix of ginger spice and fragrant flowers with a touch of juniper berry; Amrita Aromatherapy's Vetiver Perfumer, a grounding fragrance based in the warmth of vetiver and jojoba oils; Ecosafe Products' Tree Breeze air freshener and deodorizer; and Minasolve's A-Leen Aroma-3 which imparts a spicy oriental note and is extracted from the Chinese cinnamon tree.

The largest category of flavored products that hold biobased certifications with the USDA are toothpastes, including Essante Organics' Sparkle Tooth Polish, which uses peppermint oil and organic stevia; Hair O'Right International's O'Right Toothpaste N°Zero which utilizes totara, spruce and Indian soapberry extracts as well as rosemary, anise, clove and basil essential oils; and Health and Natural Beauty's line of SprinJene Natural toothpastes, which includes cavity protection, sensitivity relief and flouride-free varieties. There are also a handful of secondary ingredients, such as Colonia Chemical's Cola Fax CPE-K water-soluble emulsifier and their Cola Mate La-40 sulfate-free surfactant.

Although preference for biobased ingredients is growing within the F&F industries, from consumers to ingredient formulators, there are several challenges hindering these industries.

Industry Challenges

Biobased flavors and fragrances are frequently derived from essential oils, which are manufactured from plant extracts. When weather fluctuations and disruptions such as natural disasters occur, this may lead to low yield of crop production, which has a significant impact on the flavor and fragrance industries. With the scarcity of raw material supply, there is often an increase in essential oil prices.[9]

For example, cinnamon bark oil experienced a drastic decrease in production levels during the early months of 2019.[10,11] This resulted in an escalated price of the essential oil. In response to the increased costs, cinnamon bark oil was susceptible to adulteration through the use of a less expensive petrochemical: synthetic cinnamaldehyde.[12]

As prices increase and consumer demand for biobased flavors and fragrances rises, this exposes the market to the possibility of ingredient fraud. This is mainly due to economically motivated adulteration, the act of intentionally replacing costly, plant-based ingredients with less expensive, petrochemical-derived synthetics with the overall goal of economic gain.[13]

Analytical proof to authenticate biobased ingredients is therefore key. To confirm biobased material, techniques like carbon-14 testing are used to differentiate between plant-based and petrochemical-derived ingredients.

Why Carbon-14?

Using biobased ingredients fulfills demands for eco-friendly and naturally sourced products.

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However, due to economically motivated adulteration, the authentication of the source of ingredients labeled biobased is critical. Incorporating biobased testing for naturally sourced ingredients through carbon-14 analysis is a reliable option used to yield the percentage of biobased content within flavor and fragrance ingredients.

All material that was once living contains a known amount of the radioactive isotope, carbon-14, while there is no carbon-14 present in fossil fuel-derived material.[16] When it comes to analyzing flavor and fragrance samples, the analysis is standardized under either ASTM D6866 or ISO 16620-2, both of which are used for determining the biobased content of solid, liquid and gaseous samples through radiocarbon analysis.[14,15] Through the use of an accelerator mass spectrometer instrument, the amount of carbon-14 present in a given sample can be counted. This yields a result that is reported as percent biobased content, which can range between 0% and 100% biobased. The result depends on the portion of biobased content, or in other words, the amount of carbon-14 present.[17]

Suppliers, manufacturers and distributors can submit their flavor or fragrance samples to carbon-14 laboratories in order to receive a report containing the portion of biobased content present[a,b].

Conclusion

With consumer preference for plant-based flavor and fragrance ingredients on the rise, it is necessary to communicate plant-based material in a way that resonates with consumers. Using the term biobased acts as a solution to clarify ingredient sources to consumers. However, due to the high costs of plant-based material, many biobased ingredients are vulnerable to economically motivated adulteration. Biobased ingredient creators can ensure their products are certified by submitting samples for carbon 14 testing.

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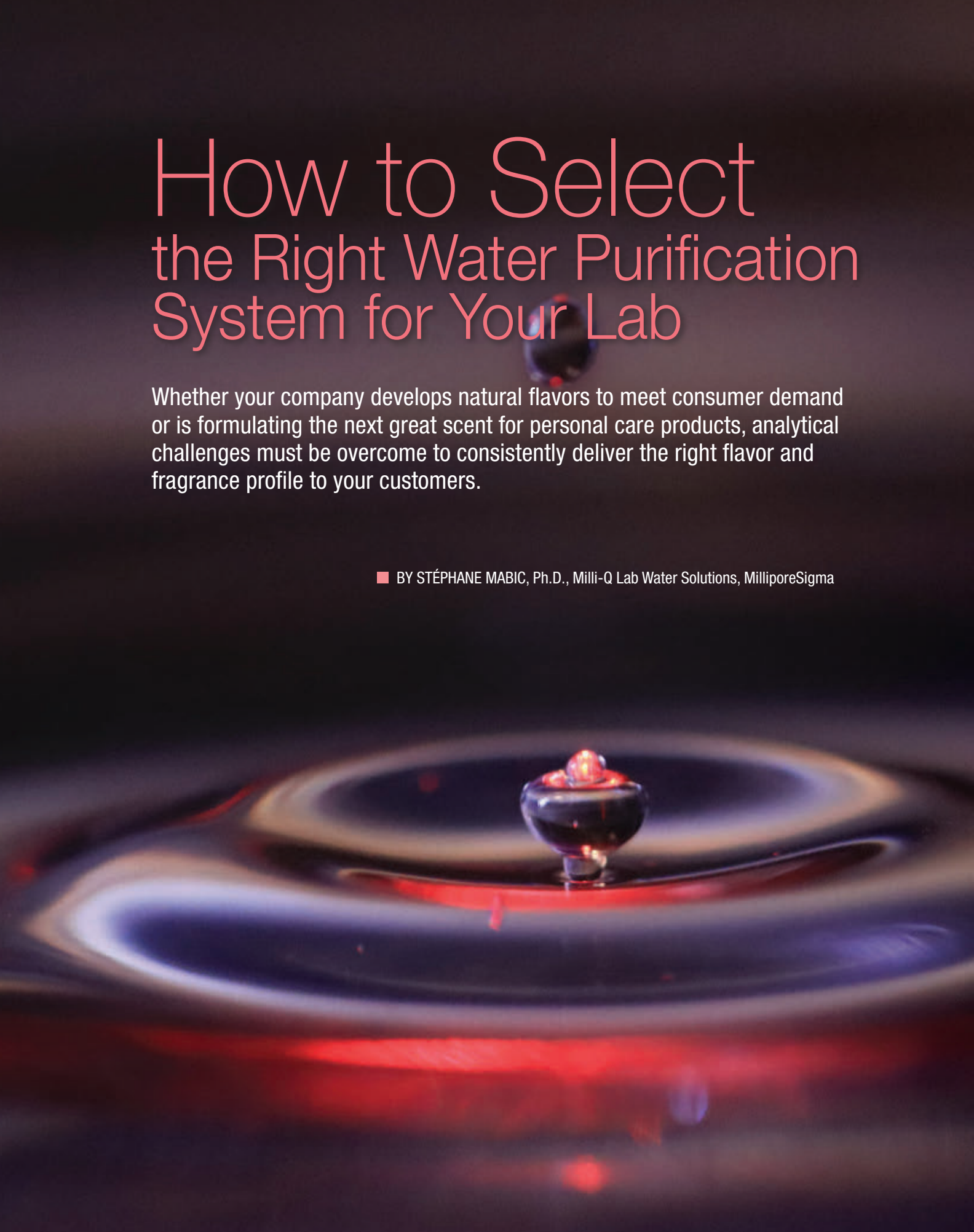
How to Select the Right Water Purification System for Your Lab

Whether your company develops natural flavors to meet consumer demand or is formulating the next great scent for personal care products, analytical challenges must be overcome to consistently deliver the right flavor and fragrance profile to your customers.

BY STÉPHANE MABIC, Ph.D., Milli-Q Lab Water Solutions, MilliporeSigma



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Purified water is a ubiquitous reagent in most of the analyses performed in a flavor and fragrance (F&F) laboratory, and its purity is of paramount importance for delivering accurate and reliable results. F&F applications, such as assessing the purity of natural ingredients or essential oils, will likely require a combination of both pure and ultrapure water. The highest-quality ultrapure (Type 1) water is recommended for HPLC, LC-MS, GC-MS, GCO, as well as for elemental analyses. Pure (Type 2) water is required to prepare reagents and solutions and is also the predominant component of microbiology media formulations. Special care must be taken to select the correct water quality as contaminants, such as heavy metals, chlorine, ammonia and bacteria, may impact analyses.

Because you need to focus on obtaining accurate and reproducible results, it's important to ensure your lab is equipped with a water purification system that delivers consistently high-quality water that meets all your purity needs. Choosing a water system can seem like a complicated process, but by thoroughly evaluating your situation at the beginning of your search and considering a few key parameters, you can make the selection a little easier and have greater confidence in your final choice.

Determine Your Water Quality Needs

It's important to know that several types of laboratory water exist. These water grades are defined by standards, which help ensure not only that the correct water type is used for a specific application, but also that cost is considered, as Type 1 ultrapure water is more expensive to produce than Type 2 or Type 3 pure water.

With this in mind, identify the different situations in which purified water is used in your laboratory and for which applications. Type 1 water is required for critical laboratory applications, including mobile phase preparation for HPLC or IC; preparation of blanks; standard and sample dilution in HPLC, GC, AA, etc.; and buffer and cell culture preparation for mammalian cell culture.

Type 2 water is used in more general applications, such as buffer and microbiological culture media preparation, as feed to other laboratory systems (Type 1 water systems, dish washers and cell culture incubators). Finally, Type 3 water is the lowest laboratory water grade and is used in glassware rinsing, heating baths and autoclaves or as feed to Type 1 water systems.

F-1 Parameters to consider when selecting a water purification system for the laboratory.

- ✓ Water quality
- ✓ Total volume needs
- ✓ Monitoring and traceability
- ✓ Certification and compliance
- ✓ Sustainability
- ✓ Design of the building/lab

→ Pure and ultrapure water solution

F-2 **Different technologies commonly used in advanced water purification systems and the contaminants they remove.**

	Reverse Osmosis (RO)	Electro-deionization (EDI)	Bactericidal UV Lamp	Photooxidative UV amp	Activated Carbon	Ion Exchange
Ions	X	X				X
Organics	X			X	X	
Particles	X					
Bacteria	X		X	X		

Depending on your situation, you will need to select a system that can remove water contaminants and produce pure or ultrapure water, or both (**F-1**). As no one technology can remove all contaminants, several purification technologies are generally combined to produce pure and ultrapure water (**F-2**). During your evaluation process, pay careful attention to the technologies used by the systems to make sure you will be able to consistently achieve the water quality needed over time, while also minimizing operating costs.

Evaluate Your Total Water Volume Requirements

Based on the list of your purified water points of use and applications, calculate approximately how much water you require per day for each water type. This will provide you with the basic information you will need to discuss recommended installation possibilities with your water purification system vendor. In your estimate, don't forget to take into account days when greater volumes of water may be required.

Understand the Importance of Monitoring and Traceability

It is essential to know that your lab water purification system is continuously able to meet the specifications for your water quality needs. Monitoring tools are commonly used for this purpose. Resistivity monitors measure the ionic purity of water (an 18.2 MΩ·cm reading means that the product water is ion-free, as ultrapure water should be), and total oxidizable carbon (TOC) meters indicate the total amount of organic material present in water. The TOC of ultrapure water is expected to be at or below 5 ppb (or µg/L). Depending on the application, both resistivity and TOC values may be required, so these criteria should be considered in your choice of water purification system.

Being able to trace and record water quality is also important, especially for labs working in regulated environments. Integrated system software and web-based solutions now facilitate data management, enable remote access to the system dashboard and provide long-term electronic archiving.

Some modern purification systems are equipped with digital touchscreens, which simplify water quality monitoring and make system operation more intuitive. Some more recent systems may also be remotely monitored and controlled, giving you greater assurance of your lab's productivity when off-site.

Consider Certification and Compliance

As part of your system selection process, you may also wish to investigate aspects concerning quality assurance. Look for systems that are produced in an ISO 9001 and ISO 14001 registered manufacturing site and which are delivered with the necessary quality documents, such as certificates attesting to conformity, quality or calibration, for example, which will help you meet your Quality Management System requirements.

In addition, keep in mind that water purification systems must comply with regulations that govern efficiency and safety throughout the lifetime of the equipment: look for equipment with CE, UL and FCC-certification.

The water produced by a lab water purification system is also subject to standards that define the quality required for specific applications, such as those published by ASTM and ISO 3696 for laboratory applications, or those provided by pharmacopeial bodies. If the water used in your labs must comply with standards from these organizations, be sure to check this point too.

Strive for Sustainability

It's true that the operation of any laboratory water purification system has a certain impact on the environment. However, manufacturers have made great progress in the development of sustainable solutions, and water systems on the market today reflect these changes in their reduced use of potable water, electricity, mercury and strong chemicals and in the availability of purification cartridges with longer lifetimes. In addition, excessive packaging has often been reduced and documentation is usually provided as electronic files, rather than printed documents. Also, check that your vendor's systems follow European Restriction of Hazardous Substances (RoHS) and Waste Electrical and Electronic Equipment (WEEE) directives.

Keeping your system in good condition with periodic preventive maintenance is also another way to reinforce sustainability and to ensure optimum operation throughout the equipment's lifetime. It's important to make sure that your vendor has a professional service organization to meet your needs.

Don't Forget Design

By now you have determined where and when you need pure and ultrapure water, for which application(s) and in what volume and frequency. The actual design of the lab incorporates this information with other important criteria that should be considered when selecting a water system.

A larger lab may opt for a solution that involves distributing pure water through a loop or implementing a floor-by-floor set up in response to volume or water purity needs, while smaller labs may prefer to use individual systems providing pure and ultrapure water on demand. In environments subject to regulatory requirements where full system control and complete traceability is needed, lab configuration may be determined by the need to install a number of point-of-use systems using compliant data recording softwares.

Finally, don't forget that other stakeholders, such as members of building/facilities management or the purchasing department, may need to be involved in the decision. Several criteria should be considered to guide the discussion with the water purification system vendor and select the solution. p&f

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KEEP THE FLAVOR IN THE TOOTHPASTE; DON'T LOSE IT TO THE PACKAGE!

How to meet the market's demand for sustainable, safe and aesthetically pleasing packaging, without sacrificing flavor.

BY VICTORIA YEUNG, scientist, flavor technology; MANIA BANKOVA, flavors and fragrances technology; and CATALINA MONROY, worldwide director, flavors and fragrances, Colgate-Palmolive (Piscataway, NJ, US)

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The development of toothpaste started when a new product in a jar, called Crème Dentifrice, was developed by Dr. Sheffield during the 1850s. In 1873, Colgate started the mass production of toothpaste in jars. Nineteen years later, the first toothpaste tube, made out of tin, was unveiled by Dr. Sheffield. A metal shortage during World War II led to the production of mixed plastic and metal tubes. In the 1990s, all-plastic toothpaste tubes were introduced. Today, there are various types of packages for toothpaste made of polymer materials (or various types of polymer-based toothpaste packaging solutions): tube, pump and sachet. They are lightweight, durable, flexible and offer attractive designs appealing to consumers. However, growing public concern about the proliferation of plastic in the environment has created a call for laminate tubes that can be recycled with other plastic waste. So today's packaging must be environmentally responsible, contribute to product aesthetics, integrity, safety and guard against contamination and, also, preserve the flavor throughout the dentifrice shelf life.

To ensure good tasting toothpaste, researchers must consider multiple interactions that might promote flavor changes:

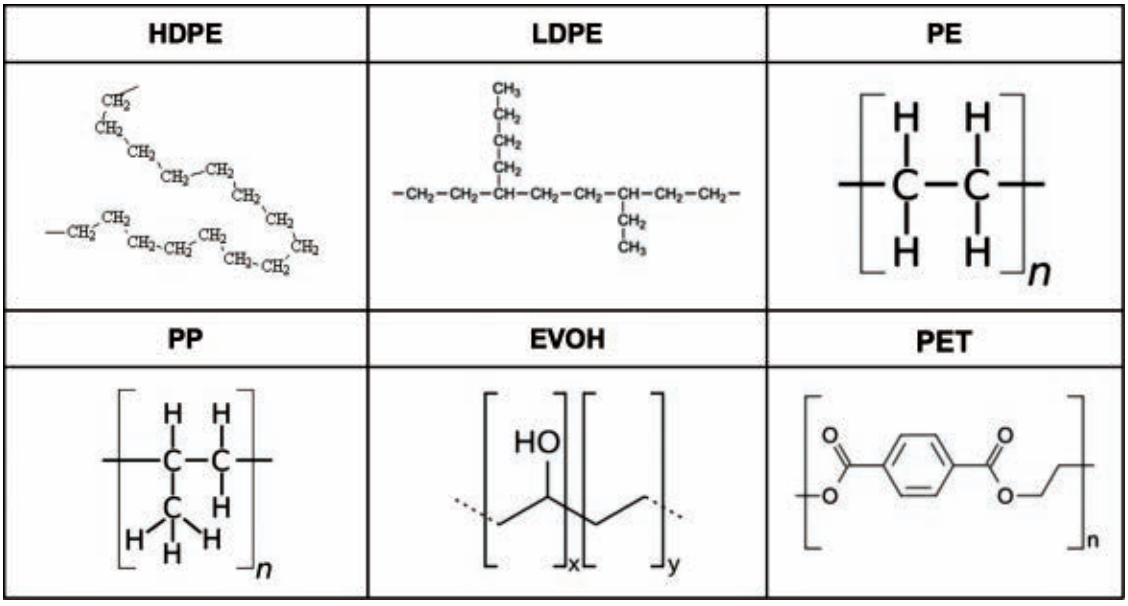
- Absorption of flavor components in packaging materials.
- Permeation of flavor volatiles through the packaging materials into the atmosphere.
- Changes in the physical properties of packaging material induced by flavor or other compounds in the product.
- Interactions of compounds in the packaging material with the flavor or other ingredients in the dentifrice.

Polymer Packaging Materials and their Affinities to Flavors

Flavor absorption is one of the most critical phenomena for managing the taste performance of the dentifrice, affecting intensity and profile characteristics. It can be affected by the following factors[1,2,3]: polymer properties (structure, morphology and quality), flavor molecule characteristics (polarity, carbon chain length, lipophilicity, molecule size and boiling point), composition of the product, thickness of the laminate polymer layer and the polymer surface in contact with the toothpaste.

Some common polymer packaging materials and their structures are shown in **F-1**. Polymer molecules with an ordered structure have a lower sorption rate for flavors because crystalline regions behave as impermeable barriers for diffusion. The higher the

F-1 Common plastic polymers and their structures. HDPE = high density polyethylene, LDPE = low density polyethylene, PE = polyethylene, PP = polypropylene, EVOH = ethylene vinyl alcohol, PET = polyethylene terephthalate.



amorphous polymer content, the higher the degree of sorption rate. High-density polyethylene (HDPE) and polypropylene (PP) have lower sorption rates than low-density polyethylene (LDPE) due to their high crystalline structures. Therefore, HDPE is better at product flavor retention than LDPE. Many volatile flavor compounds are nonpolar, so, nonpolar plastic polymers have great affinity for these molecules. Polyethylene terephthalate (PET) is polar, whereas polyethylene (PE) is nonpolar, hence, PET is often preferable from a flavor perspective. Though HDPE and PET have good performance with respect to flavor scalping, these are not well-suited for use on their own for flexible laminates and squeezable tubes because they are rigid. Another polymer is ethylene vinyl alcohol (EVOH) which has excellent barrier properties for oxygen and flavor molecules permeation that makes it ideal for wide use in the food industry to retain flavor.

Flavor molecules polarity, size and presence of functional groups determine their affinity to polymer packages. Therefore, various flavor molecules will be sorbed to different extents in the plastic layers. This, coupled with their sensory impact, might lead to flavor distortion and unacceptable taste profiles.

Evaluating Flavor Loss in Dentifrice

To investigate flavor absorption caused by the package, dentifrice is exposed to real-time or accelerated aging conditions in the proposed commercial packaging (tube, pump, sachet, etc.). Through extraction, the flavor concentration in the product is measured at the initial time point and after aging to calculate flavor loss. By extracting the flavor from the dentifrice, instead of from the package, problems associated with thermal desorption such as desorption difficulties with certain volatiles and desorption of other low-molecular weight compound residues in the package are eliminated[2]. To ensure accurate assessment of flavor changes caused by package absorption, but not flavor instability, it is desirable to conduct a study of the dentifrice in glass containers. Quantitative determination of flavor concentration

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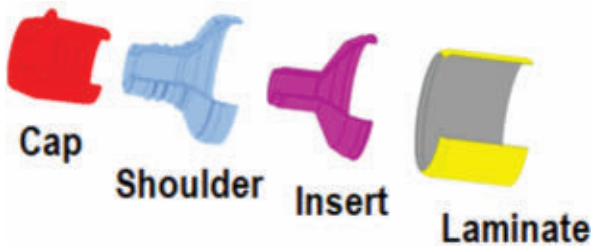
and changes in flavor profiles are measured using gas chromatography (GC) or Gas chromatography-mass spectrometry (GC-MS). Complementary organoleptic evaluations determine taste acceptability.

Flavor Interaction with the Toothpaste Tube

Typical structural elements of a toothpaste tube are a laminated polymer sleeve, cap, shoulder and, possibly, an insert (**F-2**). The laminate web is constructed of multiple plastic layers, typically HDPE film and other materials to ensure aesthetic performance and, most importantly, prevent significant flavor loss. The barrier film is positioned between the outer multilayer that is in contact with the environment and the inner multilayer that is in contact with the dentifrice. Flavor molecules can interact with other toothpaste ingredients to be retained in the dentifrice matrix and those that are free can be absorbed by the inner multilayer film up to the barrier which protects the flavor from migrating into the outer layers and atmosphere (**F-3**). Therefore, absorption is driven by the contact with the inner laminate and increases with its thickness.

The most commonly used barrier materials that have proven to provide good flavor protection are aluminum and EVOH. Based on extensive analytical research we have established that both types of barriers ensure no more than 10-15% flavor loss in the body of the tube for the toothpaste shelf life. Parallel organoleptic evaluations have confirmed that these changes are not consumer perceivable.

F-2 **Structural elements of laminate tubes**



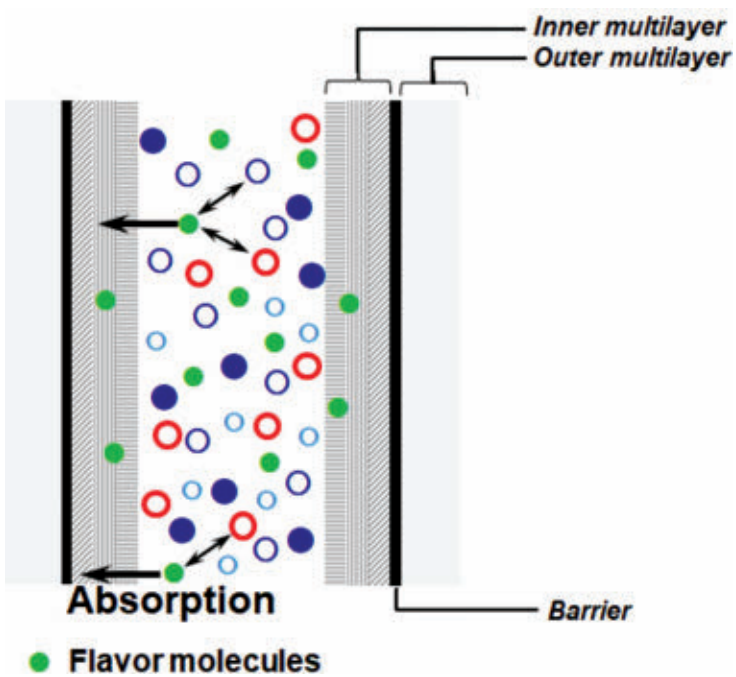
Laminate webs are also available without barrier layers but they have proven to be unsuitable for oral care products because of pronounced flavor scalping. In such types of packages, toothpaste can lose 80-95% of the flavor. This significantly compromises taste experience, reduces freshness perception and allows base off-notes to dominate.

Toothpaste flavor interactions also occur at the tube shoulder that is typically made of HDPE. In this case the toothpaste in the beginning of the tube that is in direct contact with the shoulder tends to have comparatively high flavor loss of 40-60%. One of the best available industry solutions for reducing flavor scalping is to use tube shoulder inserts made of PET. As discussed, PET is known for its good barrier properties and it helps to reduce flavor loss to 20-30%. Some other options are using PE/EVOH shoulder liners and aluminum foil seals at the tube orifice, but flavor loss studies have concluded that these are less effective.

The amount of flavor absorption varies with package size. The higher the ratio of contact laminate surface area over product fill weight, the higher the flavor absorption (**F-4**). Or, simply said, in small packages of 5-20 g fill weight, the flavor loss is higher due to the fact that toothpaste interacts with a larger polymer surface.

Research has established that the flavor loss in toothpaste rapidly occurs in the first 3-4 weeks at room temperature (25°C, 60%

F-3 **Interactions of flavor molecules in laminate packaging**



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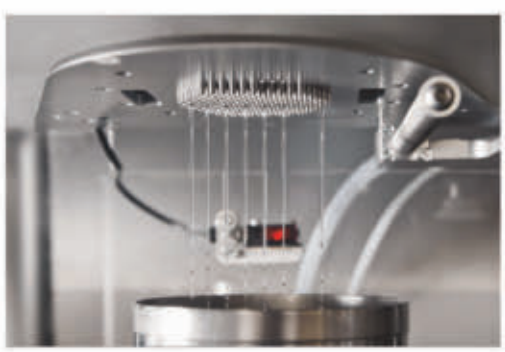

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F-4 **Flavor loss in relation to contact laminate surface area and fill weight**

Package size	170 g	113 g	21.25 g	4.25 g
Contact Laminate Surface, mm^2	104	118	280	1330
Fill weight, g				

Increase in flavor loss

relative humidity), then reaches almost a plateau with a very slow gradual increase during the dentifrice shelf life. A similar trend is observed at accelerated aging conditions with initial rapid flavor loss within one week.

In Pursuit of Sustainability

In-depth knowledge of toothpaste polymer packages, plastic/product interactions and a strong vision for a more sustainable future have led to the development of the first-of-its-kind recyclable toothpaste tube, by Colgate, that has earned recognition from the Association of Plastic Recyclers (APR) in North America and RecyClass in Europe. It's based on HDPE, the widely recycled "No 2" plastic. Using a unique recipe for multilayered laminate of sheets composed of more than one grade of HDPE, the new recyclable tube is not only easy to squeeze, durable to protect the integrity of the product and meets the demand of high speed production, it also delivers toothpaste with high flavor performance. The well-structured tube uses a barrier layer of EVOH, which Colgate has shown to be compatible with the #2 recycling system, in an asymmetrical laminate structure that places the EVOH layer closer to the toothpaste and reduces flavor scalping into the PE. The design ensures flavor loss within consumer acceptable range by confirmation through extensive analytical testing and organoleptic evaluations. This sets new standards for innovation where new polymer technology development, engineering and good taste work together to increase product sustainability and deliver to consumer expectations.

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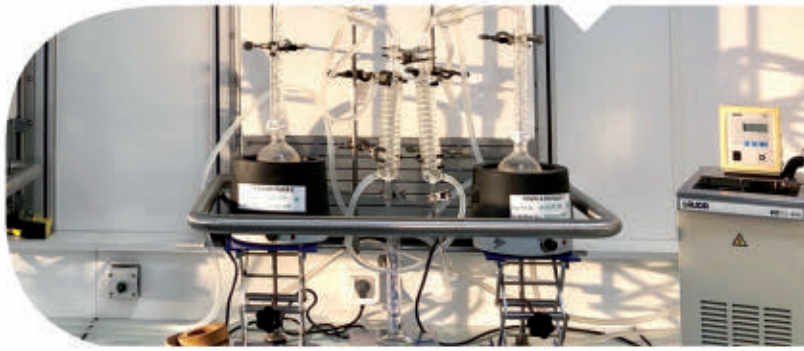

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THE END OF ENDS?

Will Flavor Bans Break the Vaping Industry?

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BY ALEX MACKENZIE, associate editor

E-cigarettes, vaping devices, electronic nicotine delivery systems (ENDS) and electronic non-nicotine delivery systems (ENNDS) have been the subject of much recent attention. Concerns about their impact on user health and their increasing popularity with young people have driven the majority of recent bans and restrictions against them. The FDA has recently enacted an enforecment policy which could effectively bar the manufacture and sale of all flavored vaping cartridges leaving tobacco and menthol as the only permissible flavors[a]. The policy does not yet include often inconvenient tank liquids, as these are seen to be less appealing to minors, but a further extension of federal legislation to cover all flavored e-liquids doesn't seem far-fetched or far off.

In order to understand what is needed to build the future of the vaping industry, it is essential that we look at its past. The following timeline outlines some of the most important scientific and legal milestones throughout the industry's nearly 100-year long history.

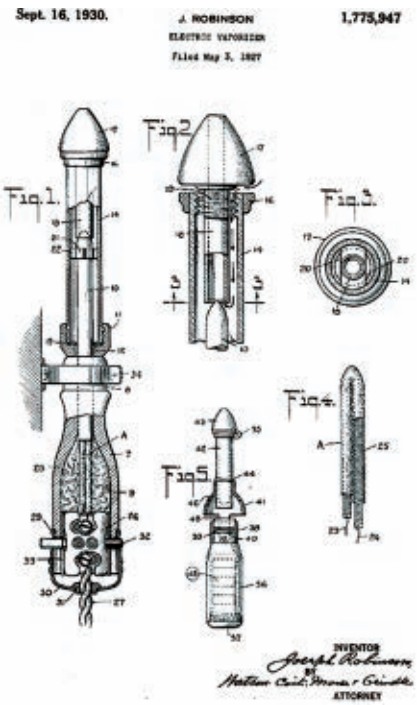
Timeline

1927

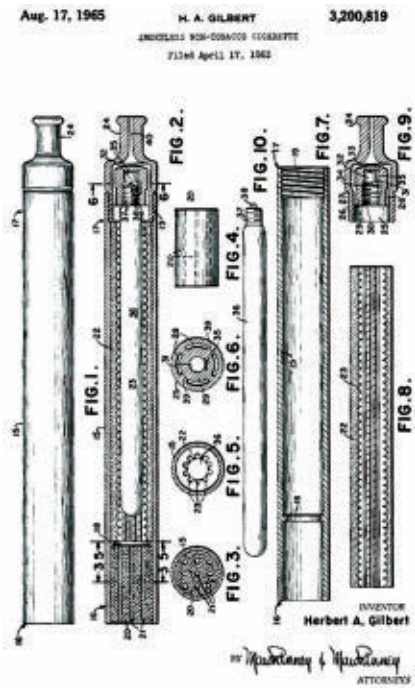
The first patent for a vaporizing device was submitted by Joseph Robinson in 1927. Patent 1,775,947 was subsequently granted in 1930. Robinson's invention was designed to hold and heat medicine to create inhalable vapors while protecting the user from burns by insulating and distancing the heating elements from the device's handle.[1]

1963

The first patent for a smokeless and tobaccoless cigarette was submitted by Herbert A. Gilbert in 1963. Patent 3,200,819 was subsequently granted in 1965. Gilbert's device was intended to act as a



Robinson Patent



Gilbert Patent

[a] *https://www.fda.gov/news-events/press-announcements/fda-finalizes-enforcement-policy-unauthorized-flavored-cartridge-based-e-cigarettes-appeal-children*

safe alternative to combustible cigarettes by using flavored liquids, in as simple a form as mentholated water, to create moist, breathable air. Gilbert also acknowledged the potential therapeutic application of his device for the delivery of pulmonary medications.[2]

1979

Phil Ray and Norman Jacobson coined the term "vape" in 1979 in the midst of creating an evaporation style nicotine device. Ray and Jacobson also conducted the first formal research on nicotine delivery.[3]

1990s

While a large number of patents were filed during the course of the 1990s and early 2000s, the final step towards commercialization of these products was hindered by the FDA's 1998 denial of a major U.S. tobacco company's attempt to gain permission to market and sell their early e-cigarette device, which was relatively similar to modern versions.[3]

2003

Hon Lik, a pharmacist in Beijing, China, created the first commercially successful e-cigarette in 2003. Lik developed the device in response to the death of his father as a result of lung cancer brought on by smoking.[3]

2006

The first electronic cigarettes were imported into the United States and Europe with the first U.S. import ruling on August 22, 2006.[3]

2008

The World Health Organization (WHO) issued a proclamation on September 19, 2008, stating that e-cigarettes were not considered legitimate alternatives or aids for those seeking to quit traditional cigarettes. The statement also demanded that companies remove any and all marketing that claimed or insinuated that the WHO had deemed such products safe or effective.[3]

2009

The first pieces of U.S. legislation regarding e-cigarettes were passed at multiple points throughout 2009. The first measure was taken in March when the FDA directed the rejection of all electronic cigarettes into the United States by U.S. Customs and Border Protection and included e-cigarettes to Import Alert 66-41. E-cigarette company Smoking Everywhere had its shipments refused under the claim that they were unapproved drug delivery devices/combination drug-device products that were not properly registered with or pre-approved by the FDA. Smoking Everywhere retaliated against the FDA's attempt to ban its products on April 28

by filing a federal complaint, which stated that its products were, in fact, tobacco products, over which the FDA held no jurisdiction at the time.[3] The FDA was then granted said jurisdiction in June when the Family Smoking Prevention and Tobacco Control Act was signed into law by President Obama.[4]

The FDA also began its process of testing e-cigarettes in 2009, with the first test beginning in May. This first test looked at 18 cartridge devices from Smoking Everywhere and NJOY. The test indicated that tobacco-specific nitrosamines (TSNAs) were present in the liquid at levels comparable to those present in FDA-approved products used for nicotine cessation. The test also found that one of the 18 cartridges contained a non-toxic level of diethylene glycol within the liquid. However, neither TSNAs nor diethylene glycol were found in the vapor. Additionally, the test revealed that some cartridges contained trace amounts of nicotine despite being labeled as 0mg. In July of 2009, the

I was able to speak with Joanna Drake, General Counsel for the Flavor and Extract Manufacturers Association of the United States (FEMA) about the implementation of the FDA's most recent update to their enforcement guidelines and FEMA's stance on the use of flavorings in vaping products.

Joanna Drake

Alex Mackenzie [AM]: What is the most important thing to know about the recent updates to the FDA's vaping regulations?

Joanna Drake [JD]: The recent updates are FDA's attempt to curb the growing prevalence of use of cartridge-based e-cigarettes among American youth. Data from the National Youth Tobacco Survey, conducted by the FDA in conjunction with the Centers for Disease Control and Prevention (CDC), show that more than 5 million U.S. middle and high school students use e-cigarettes. The FDA also point to other federal surveys which suggest that young Americans are attracted to certain flavored e-cigarette products. Through its recently announced enforcement policy, the FDA will prioritize enforcement against vaping product manufacturers that fail to take adequate measures to prevent access to minors, including their marketing efforts, as well as those manufacturers who have not received FDA approval to market and sell those particular flavored cartridge-based vaping products.

AM: What does the new FDA policy mean for those creating flavors and products for the e-liquid industry?

JD: While FDA is not banning flavors in vaping products, beginning February 6, 2020, FDA will prioritize enforcement against certain flavored e-cigarette products by focusing on those products the agency believes are popular with and easily accessible to kids, such as flavored (other than menthol and tobacco flavored products), cartridge-based vaping products. In response, major manufacturers and retailers will likely remove these products from the shelves until they submit a premarket tobacco product application to the FDA and receive approval from the agency to market and sell that particular flavored vaping product.

AM: Where does FEMA stand with regard to vaping?

JD: Since 2013, FEMA has made public its position on the safety and regulatory authority to use flavors in vaping products due to its ongoing concerns about vaping product manufacturers marketing their flavored vaping products as safe solely because the flavor ingredients are FEMA GRAS. FEMA GRAS status does not demonstrate safety for uses of flavors intended for inhalation, such as use in tobacco products; rather, the FEMA Expert Panel evaluates the safety of flavor ingredients only under their conditions of intended use in food and does not evaluate flavor ingredients for their use in vaping products, tobacco products, or any other uses that are intended for inhalation. FEMA does not support the use of flavors in any tobacco products in the absence of rigorous safety assessments performed by the manufacturers and marketers of such products that demonstrate the safety for these uses.

FEMA's full statement is available publicly on their website: "Safety Assessment and Regulatory Authority to Use Flavors: Focus on Vaping Products."

https://www.femaflavor.org/safety-regulatory-authority-use-flavors-focus-vaping-products

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FDA published a press release aimed at deterring e-cigarette use which reiterated concerns about the potential for e-cigarettes to be marketed to minors, their lack of adequate health warnings and their potential harm as a result of the chemicals that were found in the liquid.[3]

Once the FDA was granted authority over tobacco and nicotine products and had released their July statement, many states began passing legislation regulating e-cigarettes and ENDS. In August 2009, the first ban on the indoor use of e-cigarettes passed in Suffolk County, New York. The law also made it illegal to sell e-cigarettes to anyone who was younger than 19 years old.[5] In September 2009, California voted to ban all in-state e-cigarettes sales, but the bill was vetoed by Governor Schwarzenegger. In the same month, Amazon pulled all electronic tobacco products and prohibited their sale on its website. Shortly after, PayPal followed suit by freezing the accounts of e-cigarette vendors within the United States and barring such companies from doing business through PayPal. Finally, in November 2009, New Jersey passed a bill which included e-cigarettes in a state-wide public smoking ban.[3]

2010

In 2010, the Smoking Everywhere case continued with several injunctions and appeals until December when the U.S. Court of Appeals ruled that the FDA only has the authority to regulate e-cigarettes to the same extent that they regulate standard tobacco products with a caveat for products that make claims of therapeutic or health benefits.[3]

2011

By 2011, the results of the first independent studies on e-cigarettes began to be published, starting with "Electronic Cigarettes As a Smoking-Cessation Tool" in the *American Journal of Preventive Medicine* in February of 2011. It found that e-cigarettes hold the potential to help people quit smoking traditional cigarettes based on the increased rate of abstinence after six-months compared to traditional cessation products.[6] In August, the journal *Addiction* published a study which provided strong evidence that e-cigarettes were successfully helping smokers to quit and/or reduce their use of traditional tobacco products and keeping former smokers from returning to cigarettes. The first clinical trial results, titled "Effect of an electronic nicotine delivery device (e-Cigarette) on smoking reduction and cessation: a prospective 6-month pilot study," were published in October in *BMC Public Health*. The results suggested that e-cigarettes could be more effective than the nicotine replacement therapies that had existed previously for smoking cessation and noted that they were especially useful for those that do not have adequate motivation to quit smoking.[7]

2012

2012 saw the creation of a number of events and organizations in support of the fledgling vaping industry. In March alone, the first VapeBash took place in Chicago, IL., the Smoke-Free Alternatives Trade Association (SFATA) was formed and German citizens marched in protest of raids on stores selling vaping supplies. In June of 2012, the director of the Centers for Disease Control and Prevention (CDC), Thomas Frieden, was issued an alert by the U.S. Inspector General's office regarding his potential involvement in the illegal use of federal funds to promote and implement a range of restrictions on tobacco products.[3]

2013

A number of petitions, letters and presentations were delivered to and from both sides of the issue in 2013, but without substantial change to legislation, until October, when the European Union approved e-cig Amendment 170 to the EU Tobacco Products Directive.[8] In the same month, Punjab, India outlawed all e-cigarettes.[9] In November, London's Royal Society held the first E-Cigarette Summit where available data on e-cigarettes was presented and scrutinized so as to offer more accurate information for use in political debates on the issue.[3]

2014

2014 kicked off with the *BMC Public Health* publication of Igor Burstyn, Ph.D.'s "Peering through the mist: systematic review of what the chemistry of contaminants in electronic cigarettes tells us about health risks" in January. Burstyn reviewed over 9,000 observations on the chemical qualities of the vapor and liquid associated with e-cigarettes and verified that the levels of toxins in e-cigarettes were inconsequential, too low to pose any health risk to the smoker or bystanders.[10] In the same month, the Surgeon General released "The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General, 2014."[11] By May of 2014, the European Union had adopted the Tobacco Products Directive (Directive 2014/40EU), which it allowed member states two years to implement.[12] And in November, Oxford Dictionaries declared "vape" to be the word of the year.[3]

2015

Throughout 2015, advancements continued in the FDA's deeming regulations as well as several resisting lawsuits and interventions. In February, the Center of Environmental Health announced their initiation of legal action against 19 companies for alleged violations of California Proposition 65. Indiana passed HB 1432, barring e-liquids from being sold to retailers or distributors without a permit, in May. On the other hand, in August, Public Health England announced their independent review, conducted by experts, concluding that e-cigarettes are substantially less detrimental to the user's health than traditional tobacco products and pose a viable solution to help individuals quit smoking.[3]

2016

2016 saw a veritable flurry of legal activity surrounding e-cigarettes, ENDS and other vaping devices. January kicked off the year with the signing of the Child Nicotine Poisoning Prevention Act of 2015 (S142) into law by President Obama. The law extended existing packaging standards for the prevention of child poisoning to all e-liquid products.[13] In March, a ban on e-cigarettes was passed by the U.S. Department of Transportation.[14] In the UK in April, The Royal College of Physicians released "Nicotine without smoke: Tobacco harm reduction" a 200-page report which used the most up-to-date scientific techniques to examine multiple factors concerning ENDS. The report concluded that e-cigarettes provide a less risky alternative to traditional smoking.[15] In May, the FDA released their completed deeming regulations and 17 U.S. Senators sent a letter to the FDA seeking further regulatory action on flavored ENDS products and their marketing.[3] Pennsylvania, in July, passed a wholesale tax at 40% on e-liquids, vaping devices and the majority of vaping accessories which took effect October 1, 2016, and required manufacturers, retailers and vendors to purchase and apply for licensing.[16] WHO published "Electronic Nicotine Delivery Systems and Electronic Non-Nicotine Delivery Systems (ENDS/ENNDS)" in August after receiving a request for information from the Conference of the Parties to the WHO Framework Convention on Tobacco Control.[17] In September, the FDA distributed their first round of warning letters regarding sales of newly deemed tobacco products to minors, and, in November, California's

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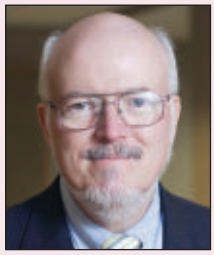
I spoke with Patrick McNamara, partner at Scarinci Hollenbeck, about the current legal state of the vaping industry in the wake of the enforcement regulations and what we can expect to see in the months to come.



Patrick McNamara

Alex Mackenzie [AM]: Why is vaping getting so much attention from the FDA?

Patrick McNamara [PM]: The FDA is looking into vaping devices out there due, in significant part, to the number of young people using e-cigarettes and concern regarding increased nicotine addiction in children and adolescents resulting from that use. Vaping device companies have tried not to market these devices in a way to be regulated as a delivery device to help people stop smoking cigarettes because they don't want to be regulated as a delivery system.

AM: Why is the FDA targeting legal cartridge products when the majority of deaths and injuries have been caused by illicit street products?

PM: Part of it is driven by concerns about abuse of these products by minors and then leading them into using vaping devices for illegal substances such as TCH, high grade marijuana, fentanyl and whatever else is out there. These cases that were being reported a few months ago were of some really bad lung injuries and yes, most of it was with illegal substances.

AM: What are some current and upcoming pieces of legislations and bans of note?

PM: New Jersey Governor Phil Murphy just signed a bill into law that is scheduled to take effect in 90 days, assuming there is no litigation to challenge the law. It prohibits the sale, distribution and offer for sale of vapor products that have a "characterizing flavor" other than tobacco. It specifically lists flavors such as "any fruit, chocolate, vanilla, honey, candy, cocoa dessert, alcoholic beverage, herb, mint, menthol, wintergreen or spice flavoring." Almost all 50 states have passed some type of bill preventing the sale of e-cigarettes and vaping devices to minors or persons under the age of 21.

AM: Why are flavored products and cartridges taking the brunt of the legislation?

PM: I think the FDA is looking at the data from federal surveys like the National Youth Tobacco Survey on the top e-cigarette products for youth which is dominated by flavored e-cigarette products rather than tobacco flavored e-cigarette products.

AM: What should those in the flavor and fragrance industry know about the vaping and e-cigarette market and what is your advice for flavor and fragrance developers currently involved in the creation of vaping flavors?

PM: Companies in the F&F industry are going to have to pay very close attention to what type of legislation and/or new regulations come out of Washington, D.C. this year, as well as monitor that the state of the law is not only in the state they are located in, but also in those states where their flavor product could be incorporated into a vaping device and sold to consumers. States like New Jersey are passing such laws and thus call into question whether companies located in New Jersey should consider whether they want to continue to be in the business of selling such flavors to vaping and e-cigarette manufacturers. They should also be looking at their insurance policies to see if they are insured—or not—in the event of such litigation. They will also have to make a close examination of the terms and conditions in their sales agreements, and also whether they are being indemnified from any threat of litigation. All these steps should be taken before considering whether to start or to continue to supply flavor products for vaping devices.

p&f

Proposition 56 was passed, enacting a 60-70% wholesale tax on the sale of vaping products in the state. However, Colorado and North Dakota's vaping tax ballot initiatives, Amendment 72 and Measure 4, were both voted down in the same month.[3] The year closed out with the U.S. Surgeon General's publication of "E-Cigarette Use Among Youth and Young Adults" in December.[18]

2017

In May of 2017, the FDA published "Three-Month Extension of Certain Tobacco Product Compliance Deadlines Related to the Final Deeming Rule," a guidance document that announced the FDA's decision to postpone the enforcement date for the requirements that had been enacted by the final deeming rule.[19] The FDA then revealed their multi-year plan for tobacco and nicotine regulation in July, which is aimed at lowering the number of tobacco-related deaths.[20] In November, *Scientific Reports* published "Health impact of E-cigarettes: a prospective 3.5-year study of regular daily users who have never smoked" which found no discernable decline in any of the observed health indicators for e-cigarette users who never used traditional tobacco products.[21]

2018

The FDA began their first enforcement efforts in 2018 with a nationwide undercover investigation that supplied evidence mitigating issuance of 56 warning letters to internet-based retailers and civil money penalty (CMP) complaints to six retail locations concerning unlawful sales of ENDS to underage individuals. The FDA also petitioned ENDS manufacturers to share data on products popular with youth and spoke to eBay regarding questionable products listed to their site, which eBay promptly removed. In May, an additional 17 warning letters were sent to retailers, manufacturers and distributors for using flavors and marketing attractive to minors. By September, the FDA had issued more than 1,300 CMP complaints and warning letters for selling ENDS to minors illegally.[20]

2019

2019 kicked off with The UK Electronic Cigarette Research Forum's publication of its "Electronic Cigarette Research Briefing" in association with Cancer Research UK, in January.[22] By December 17, over 2,500 hospitalizations were reported for pulmonary injuries linked to vaping as well as 54 confirmed deaths.[20] On the 20th of December, President Trump signed an amendment to the Federal Food, Drug, and Cosmetic Act which raised the minimum age of purchase for tobacco and nicotine products from 18 to 21.[23]

2020

Already this year, California lawmakers proposed Senate Bill 793 in January aimed at banning flavored tobacco product sales in physical stores within the state.[24]

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The progression of research and legislation since the initial invention of vaporizers has grown exponentially, and we should expect to see more of both over the coming months and years. There are a number of longitudinal studies being carried out on the health impacts and reported use of vaping products, by both minors and adults, as well as their correlation to traditional tobacco use in terms of initiation and cessation[a]. Unfortunately, these types of studies take time, and it may be decades before we have a solid understanding of the full impact that vaping has on health. While vaping is generally considered, at this point, to be the lesser evil when compared with traditional cigarette smoking, which kills 480,000 American every year, there is still a clear risk associated with the use of ENDS and ENNDS, especially when used by minors[b]. However, it is important to note that the majority of cases of injury and nearly all cases of death linked to vaping have occurred in conjunction with the use of unlicensed, unregistered and unregulated THC street cartridges, not the name brand nicotine or non-nicotine vapes available at licensed retailers[c]. Nevertheless, many states have imposed their own bans, restrictions or taxes to make all vaping devices less easily accessible, especially to those under age[d].

If the vaping industry is going to survive the mounting restrictions against it, steps must be taken to ensure that companies not only respond to new regulations quickly but are also able to anticipate them and remain proactive with regards to innovation and marketing.

Resources

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[b] *https://www.cdc.gov/tobacco/data_statistics/fact_sheets/fast_facts/index.htm*

[c] *https://www.cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease.html*

[d] *https://www.publichealthlawcenter.org/resources/states-and-tribes-stepping-protect-communities-dangers-e-cigarettes-actions-and-options*

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Senior Flavorist, abelei flavors;
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Organoleptic Characteristics of Flavor Materials

This month's column features discussions on organic hibiscus, elderberry, turmeric root and more.

Organoleptic Evaluation Panelists

- **Gerard Mosciano**, Consulting Flavorist
- **Deborah Barber**, Senior Flavorist, FONA
- **Cyndie Lipka**, Master Flavorist, Prinova
- **Tom Gibson**, Director, Flavor Architect, Flavor First Flavors
- **Robert Pan**, Senior Flavorist, T. Hasegawa
- **Alpa Roman**, Senior Flavorist, Flavor & Fragrance Specialties
- **Bill Aslanides**, Senior Flavorist, Synergy Flavors, Inc.
- **Aparna Oak**, Director of Flavor Innovation, Imbibe

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Organic Hibiscus FE 25298

Supplier: Horner International
GRAS, CAS# 84455-19-6, *Hibiscus abelmoschus,* natural
Odor: @ 100%. Fruity, berrylike, fermented, earthy, sweet and slightly brown.
Taste: @ 0.3%. Astringent, floral, sweet, fruity, green and berrylike.
Possible applications: The sweet, fruity notes of this extract will stand alone nicely in a beverage application. In other flavors, it will add depth, especially in pomegranate, raspberry, blueberry, cherry and red wine.
➤**Horner International:** *https://horner-intl.com*

Costus Oil Natural 100

Supplier: Excellentia
FEMA# 2336, CAS# 8023-88-9, *Saussurea lappa*
Odor: @ 100%. Waxy, musty, earthy and slightly orris rootlike.
Taste: @ 1 ppm. Waxy, dry, musty, earthy, slightly floral and orris rootlike.
Taste: @ 2 ppm. Waxy, orris rootlike, oily and floral.
Possible applications: Some versions of this essential oil have been described as dirty hair-like and wet dog. This particular product has less of the objectionable notes and more of the delicate, waxy notes and will be appreciated in raspberry, cranberry, cherry and other red berry flavors. At levels lower than 1 ppm it might be used to accentuate fatty, waxy notes in cheeses like Manchego, Parmesan Reggiano and Chevre.
➤**Excellentia:** *https://excellentiainternational.com*

2,3,5-Trimethylpyrazine Mixture Natural MN735M

Supplier: Synerzine, Inc.
FEMA# 3244, CAS# 14667-55-1
Natural Occurrence: Coffee, cocoa, beef, bread, hazelnut, emmenthal cheese, peanut, popcorn, rum, shrimp and tobacco.
Odor: @ 100%. Earthy, nutty, brown, slightly moldy, roasted and raw.
Taste: @ 2 ppm. Nutty, musty, peanut, earthy, dank and brown.
Taste: @ 5 ppm. Toasted, earthy, cocoalike, nutty, musty, slightly savory, roasted and peanut shell-like.
Possible application: Most roasted, brown flavors will benefit from the use of this pyrazine including cocoa, dark chocolate, coffee, mocha, peanut, hazelnut, baked potato, tobacco, grill, roast beef, chicken and pork.
➤**Synerzine, Inc.:** *https://www.synerzine.com*

Orange Habanero Pepper kiiNote 52409

Supplier: Omega Ingredients
GRAS, *Capsicum chinense*, natural
Odor: @ 100%. Briny, vegetablelike, sweet, spicy and fruity with green pepper notes.
Taste: @ 0.3%. Green, fruity, vegetablelike with green pepper notes.
Possible applications: Orange habaneros are among some of the hottest peppers with Scoville heat units between 100,000 and 350,000. But fear not! This extract will impart the flavor and not the heat to flavors for dressings, vegetable juices, virgin and alcoholic beverages, and seasoning mixes.
➤**Omega Ingredients:** *https://www.omegaingredients.co.uk*

Elderberry FE 25073

Supplier: Horner International
GRAS, CAS# 91722-58-6, *Sambucus canadensis,* natural
Odor: @ 100%. Fruity, brown, slightly jammy.
Taste: @ 0.2%. Fruity, brown, berrylike, raisinlike, astringent and slightly bitter.
Possible applications: This is another extract which will shine solo or partnered in sweet brown flavors like raisin, prune, fig, cola, tamarind and red wine.
➤**Horner International:** *https://horner-intl.com*

1,4-Cineole

Supplier: Sigma
FEMA# 3658, CAS# 407-67-7
Natural occurrence: Anise, cardamom, cocoa, cubeb, grapefruit, juniper, lemon, lime, mandarin, lavender and tea tree.
Odor: @ 100%. Camphoraceous, cooling, green, slightly tarry and oily.
Taste: @ 5 ppm. Cooling, camphoraceous, citruslike and herbal.
Taste: @ 10 ppm. Cooling, minty, citruslike and piney.
Possible applications: Unlike its nonidentical twin, eucalyptol, this chemical's cooling effect is more subdued. It will add interest and lift to mint and oral care flavors as well as anise, tarragon, root beer, mojito, pine, gin and tea.
➤**Sigma:** *https://www.sigmaaldrich.com*

Cascarilla Bark kiiNote KRN-11315

Source: Omega Ingredients
FEMA# 2254, CAS# 84836-99-7, *Croton eluteria,* natural
Odor: @ 100%. Sweet, woody, floral, balsamic and slightly camphoraceous.
Taste: @ 0.3%. Sweet, woody, herbal, balsamic and slightly spicy.
Possible applications: This extract will add unique notes to spice flavors and blends including chai, ginger and black pepper as well as vanilla, root beer, cola and herbal tea.
➤**Omega Ingredients:** *https://www.omegaingredients.co.uk*

Prenyl acetate

Source: Sigma
FEMA# 4202, CAS# 1191-16-8
Natural occurrence: Ylang ylang oil.
Odor: @ 1%. Sweet, fruity, bananalike, green, slightly floral and pear-like.
Taste: @ 2 ppm. Floral, fruity, green, sweet and bananalike.
Taste: @ 5 ppm. Sweet, ripe, fruity, floral, banana/pearlike and green.
Possible applications: This ester will enhance many fruit flavors including banana, raspberry, blackberry, pear, apple, cantaloupe and punch. It can also be used to add bouquet to floral flavors like jasmine, rose, honeysuckle and lavender.
➤**Sigma:** *https://www.sigmaaldrich.com*

Turmeric Root FE 25300

Source: Horner International
FEMA# 3086, CAS# 84775-52-0, *Curcuma longa,* natural
Taste: @ 100%. Earthy, spicy, smokey, phenolic, slightly cooling and incenselike.
Taste: @ 0.1%. Earthy, spicy, woody, drying and astringent.
Possible applications: The earthy, spicy profile of this botanical will fit nicely into barbecue, curry and other Asian, Middle Eastern and African spice blends. It will add interest to herbal/spice flavors for teas, carbonated and alcoholic beverages.
➤**Horner International:** *https://horner-intl.com*

2,5-Dimethyl-3-ethyl pyrazine Natural 80%

Source: Charkit
FEMA# 3149, CAS# 13360-65-1
Natural occurrence: Beef, beer, chicory, coffee, cocoa, malt, peanut, pork, potato chip, shrimp, rum and rea.
Odor: @ 1%. Musty, nutty, toasted, brown and molasseslike.
Taste: @ 1 ppm. Oily, nutty and brown.
Taste: @ 2 ppm. Toasted, nutty, peanut butterlike, brown and cocoalike.
Possible applications: This pyrazine will add warm, toasted notes to brown flavors like caramel, cocoa, coffee, brown sugar, molasses, rum, praline, whiskey, malt and almost all nuts including peanut, pecan, cashew, hazelnut and cashew.
➤**Charkit:** *https://www.charkit.com*

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Fricke Abfülltechnik Gmbh & Co
Fricke offers automatic dosing systems for laboratories in a number of industries including flavor and fragrance.

Gewerbepark Meißen 8
Minden North Rhine-Westphalia 32423 Germany
+49 0 571 93411 0
www.frickedosing.com

Gerstel
Gerstel provides a number of products and services across scientific industries with specialized techniques dedicated to the flavor and fragrance industry including GC-MS, thermal desorption and extraction, dynamic headspace, headspace, SPME and olfactory detection ports.

1 Eberhard-Gerstel-Platz
Mulheim an der Ruhr NRW 45473 Germany
+49 208765030 / gerstel@gerstel.com
www.gerstel.com

Milli-Q Lab Water Solutions
By MilliporeSigma a business of Merck KGaA, Darmstadt, Germany

Milli-Q Lab Water Solutions offers a broad range of pure and ultrapure water purification systems and services designed for both validated and non-validated environments.

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+1 800 645 5476
http://SigmaAldrich.com/labwater

Osmic Enterprises, Inc.

Osmic Enterprises is a provider of olfactometers for use in the precision generation and mixing of fragrances.

4242 Clough Pike
Cincinnati OH 45244-4038 United States
+1 513 675 7999 / info@osmicenterprises.com
http://osmicenterprises.com

Osmose

Osmose offers a range of innovative products for improved health and safety, energy savings and productivity in lab and production zones, including Smart-Flow and Smart-Cool air extraction systems.

Les Galeries de Beaumon
Cidex 202 bis - RD2085
Roquefort Les Pins, 06330 FRANCE
+33 04 93 77 79 74/ osmose06@osmose06.com
osmose06.com

Rudolph Research Analytical

Rudolph Research Analytical manufacturers and supplies precision laboratory instruments which are capable of testing for specific gravity, refractive index and optical rotation, among others.

55 Newburgh Rd
Hackettstown NJ 7840 United States
+1 973 584 1558 / info@rudolphresearch.com
www.rudolphresearch.com

Sentry Air Systems

Sentry Air Systems offers a variety of clean air solutions including benchtop and portable fume extractors; ductless, ducted and custom fume hoods; and portable clean rooms.

21221 FM 529 Road
Cypress TX 77433 United States
+1 800 799 4609 / sales@sentryair.com
www.sentryair.com

Shimadzu Scientific Instruments

Shimadzu Scientific Instruments provides a wide range of instruments for analytical processes including GC-MS, spectroscopy, HPLC and elemental analysis.

7102 Riverwood Drive
Columbia MD 21046 United States
+1 410 381 1227 / webmaster@shimadzu.com
www.ssi.shimadzu.com

StanhopeSeta

StanhopeSeta is a manufacturer of laboratory instruments for use in transportation, regulatory and conformant applications and flashpoint testers.

London street 47-50
Chertsey KT16 8AP United Kingdom
+44 0 193 257 5034 / ibl@stanhope-seta.co.uk
www.stanhope-seta.co.uk

Manufacturing Equipment

Contexa SA

Contexa provides robotic dosing equipment specifically designed for the flavor and fragrance industry.

Chemin du Château-Bloch, 15
Aïre Geneva 1219 Switzerland
+41 22 797 36 46 / info@contexa.ch
http://www.contexa.ch

Cybernetik Technologies PVT. LTD.

Cybernetik Technologies specializes automated systems for supercritical CO2 extraction, powder handling, liquid handling and packaging.

GAT NO. 365 Urawade
PUNE Maharashtra 412108 India
+91 20 6790 9600 / sales.automation@cybernetik.com
http://automation.cybernetik.com

ErtelAlsop

ErtelAlsop offers a variety of solutions for liquid filtration, clarification and haze, odor and particulate removal.

132 Flatbush Avenue
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+1 845 331 4552 / sales@ertelalsop.com
http://www.ertelalsop.com

Fricke Abfülltechnik Gmbh & Co

Fricke offers automatic dosing systems for laboratories in a number of industries including flavor and fragrance.

Gewerbepark Meißen 8
Minden North Rhine-Westphalia 32423 Germany
+49 0 571 93411 0
https://www.frickedosing.com

Glatt Air Techniques

Glatt provides unique process solutions for fragrance encapsulation and solidification.

20 Spear Rd
Ramsey NJ 7446 United States
+1 201 825 8700 / Info@Glatt.com
https://www.Glatt.com/en/expertise/process-technology-fff/

Pope Scientific Inc

Pope offers a wide range of equipment for use in the flavor and fragrance industry, including wiped film evaporators, molecular and hybrid stills, Nutsche filter-dryers, custom vessel systems and reactors as well as specialized solutions for cannabis.

Po Box 80018
Saukville WI 53080-0018 United States
1+ 262 268 9300 / sales@popeinc.com
http://www.popeinc.com

Vanwyk Systems B.V.

Vanwyk Systems provides compounding and software solutions for F&F production and laboratory applications including CDL, UCS, HCSD and automatic cluster dispensers.

Meubelmakerstraat 27A
Velserbroek Noord-Holland 1991 JD Netherlands
+31 23 5201530 / sales@vanwyk.nl
http://www.vanwyk.nl

Services

Agencies

Big Data Solutions – Perfumist

The Perfumist branch of Big Data Solutions offers consumer data monitoring for the fragrance industry.

4 traverse Dupont
Espace Jacques Louis Lions 6130 Grasse France
+33 61 612 7118
http://www.perfumist.fr

Dominican Perfumes

Dominican Perfumes is a multi-sensorial design agency specializing in perfume, flavor and packaging.

I 32 Guavaberry Resort
Juan Dolio San Pedro de Macoris 21000 Dominican Republic
+809 1849 655 5014 / malenacejas@gmail.com
https://www.cdelac.net

PCFiore dba Fiore Inspiragency

PCFiore offers a range of services, including strategic brand communications, flavor and fragrance ingredient and product launches, and procurement of rare technologies across the globe.

90 Park Avenue
Florham Park NJ 07932 United States
+1 973 359 4444 / pfiore@fioreinspires.com
http://www.fioreinspires.com

Certifiers

BDIH IONC GMBH

BDIH offers certification and approval services for Cosmos certified natural and organic for fragrances used in cosmetic.

L11, 20-22
Mannheim 68161 Germany
+49 (0) 62130980860 / ionc@ionc.info
http://www.bdih.de

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KLBD supplies world-wide kosher certification for the flavor and fragrance ingredients and products.

305 Ballards Lane
London N12 8GB United Kingdom
+44 208 343 6230 / rosenfeld@klbdkosher.org
http://www.klbdkosher.org

Kof-K Kosher Supervision

Kof-K Kosher Supervision provides comprehensive and efficient kosher certification for the flavor and fragrance industry and many others.

201 The Plaza
Teaneck NJ 07666 United States
201 837 0500 / pjuravel@kof-k.org
http://www.kof-k.org

Consulting

Aamirav Ingredients & Specialties Pvt. Ltd

Aamirav Ingredients & Specialties provides a range of services to the flavor and fragrance industry including distribution and warehousing services, supply chain consulting, product development, marketing and contract manufacturing.

305 Nirman Kendra Famous Studio Lane
Mumbai Maharashtra 400011 India
+91 829 116 9309 / amay@aamirav.co.in
http://www.aamirav.co.in

Ace Impact Consulting Inc.

Ace Impact offers consulting for growth, pricing and commercial strategy.

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(647) 667-7824 / contact@flavornaturally.com
https://www.instagram.com/flavornaturally/

Ajowan Consulting

Ajowan Consulting offers services relevant to production, marketing, sales and the purchasing of essential oils and other flavor and fragrance ingredients through global markets.

Rectory Cottage
Bury St Edmunds IP294BU United Kingdom
+44 783 123 1873 / HugoBovill@Ajowan.biz
http://www.Ajowan.biz

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Aleena Consulting specializes in solving your company's corporate governance issues, including internal controls.

Paricutin 246
Cuernavaca Morelos 62350 Mexico
+52 554 588 6412 / alfredo.reyes@aleenaconsulting.com
http://www.aleenaconsulting.com

All Good Scents - Just Scents Private Limited

All Good Scents is an exclusive partner of Cinquième Sens Paris in India, providing consulting and training to the fragrance industry.

603 Matrix
Prahaladnagar Ahmedabad Gujarat 380015 India
+91 794 004 6006 / care@allgoodscents.com
http://www.allgoodscents.com

AromaKnowledge

AromaKnowledge offers consulting services for the fragrance industry, including fragrance oil production and formulation, candle production and merchandising, creative perfumery and fragrance training for skill acquisition and refinement.

251 Franklin Tpke
Allendale NJ 07401 United States
+1 201 741 8357 / kari@aromaknowledge.com
http://aromaknowledge.com

Ars Aromatica Studio

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Queretaro Querétaro 76146 Mexico
+52 442 169 6311 / contacto@arsaromaticastudio.com
http://www.arsaromaticastudio.com

Atelier Olfativo

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Bogot¡ Cundinamarca Colombia
+57 320 488 3912 / ana.paez@atelierolfativo.com
http://www.atelierolfativo.com

Basile Creative Design Services

Basile Creative Design provides a range of services including creative perfumery, fragrance formulation, perfumer-consultant, formulation-consultant and creative design.

83 Surrey Lane
River Edge NJ 07661 United States
+1 201 638 0700 / davidpbasile@gmail.com
http://davidpbasile@gmail.com

Cinquième Sens

Cinquième Sens offers a variety of services from creation and consulting to training and events management for the fragrance industry.

18 Rue De Monttessuy
Paris 75007 France
+33 14 753 7916 / contact@cinquiemesens.com
http://www.cinquiemesens.com

FF Projects Ltd
FF Projects Ltd specializes in GC-MS analysis and product development for the flavor and fragrance industries.

6 Rose Court
Olney Bucks MK46 4BY United Kingdom
+44 0 1234 712770 / contact@fandfprojects.com
http://www.fandfprojects.com

Focus International LLC
Focus International works with companies in the flavor and fragrance industry, providing consultancy services, M&A, business development, market research, recruiting services and interim experts.

PO Box 8624
Cincinnati OH 45208 United States
+1 513 288 9779 / info@focusintenational8.com
http://www.focusinternational8.com

Illumination Partners LLC
Illumination Partners offers quality and operational excellence through consulting and business coaching.

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Sharonville OH 45241 United States
+1 973 570 8005 / deborah@coviellocm.com
http://dropinceo.com

Innomatrix LLC
Innomatrix provides consulting and innovation services across the perfume industry.

10010 Trail Ln
Cincinnati OH 45249 United States
+1 513 545 9507 / alemany@innomatrixllc.com
http://www.innomatrixllc.com

iSense
iSense is the first global flavor marketplace, supported by avant-garde flavor houses, delivering digitized flavor solutions.

41, rue Julien
Clermont-Ferrand 63000 France
+33 4179 839 6452 / franck.janierdubry@isensegroup.com
http://www.isensegroup.com

Leffingwell Associates
Leffingwell Associates provides a range of services and software for the perfume, flavor, food and beverage industries.

4699 Arbor Hill Rd
Canton GA 30115 United States
+1 770 887 5111 / leffingwell@mindspring.com
http://www.leffingwell.com

Mouillettes and Co SRL
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Parma 43122 Italy
+39 052 127 1457 / info@mouillettes-and-co.com
http://www.mouillettes-and-co.com

Passion Nez
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+33 61 353 3114 / contact@passionnez.com
http://www.passionnez.com

Phase Associates, LLC
Phase Associates provides comprehensive occupational safety and health consulting in compliance with OSHA and similar governing entities.

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Livingston NJ 07039 United States
973 597 0750 / ken@phaseassociate.com
http://www.phaseassociate.com

PSN Associates
PSN Associates are exclusive consultants to the flavor, fragrance and food and beverage ingredients industries.

Peter-Henlein-Strasse 4
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+49 49223 250 0948 / pieterwestdijk@psnassociates.com
http://www.psnassociates.com

Shiva Perfumatics

Shiva Perfumatics offers a range of services for the fragrance industry including workshops, olfactory training, merchandizing and branding services.

5 Shyamnagar Society L.H. Road
Surat Gujarat 395006 India
+91 940 804 3623 / blenderspalette@gmail.com
http://www.shivaperfumaticss.weebly.com

Synesthetics Inc

Synesthetics specializes is consumer odor perception through research, study design and analysis, and product development.

624 Breakwater Dr
Fort Collins Colorado 80525-3289 United States
+1 973 819 3836 / avery.gilbert@synesthetics.com
https://synesthetics.com

The Powder Room

The Powder Room is an exclusive partner of Cinquième Sens Paris in Australia and New Zealand specializing in perfume product development and training.

303/37 Swanston Street
Melbourne Victoria 3000 Australia
+61 4 2235 1611 / info@thepowder-room.com
http://thepowder-room.com

Logistics

Aamirav Ingredients & Specialties Pvt. Ltd

Aamirav Ingredients & Specialties provides a range of services to the flavor and fragrance industry including distribution and warehousing services, supply chain consulting, product development, marketing and contract manufacturing.

305 Nirman Kendra Famous Studio Lane
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Pinnacle Trucking

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http://pinnacletruck.com

Recruitment

Aston Chambers

Aston Chambers is a global executive search firm within the international flavor and fragrance industries.

Equity House, 1 The Bourse, 2nd Floor Boar Lane
Leeds West Yorkshire LS1 5EQ United Kingdom
+44 113 323 0994 / contactus@aston-chambers.com
http://www.aston-chambers.com

Focus International LLC

Focus International works with companies in the flavor and fragrance industry, providing consultancy services, M&A, business development, market research, recruiting services and interim experts.

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+1 513 288 9779 / info@focusintenational8.com
http://www.focusinternational8.com

Zing Recruiting

Zing Recruiting specializes in recruiting for the flavor and fragrance industry.

933 State Route 23
Pompton Plains New Jersey 07444 United States
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http://www.zingrecruiting.com

Toll Manufacturing

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American Custom Drying provides toll manufacturing services as well as spray drying, microencapsulation, liquid batching and on-site lab services.

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http://www.acdprocessing.com

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Training

All Good Scents - Just Scents Private Limited

All Good Scents is an exclusive partner of Cinquième Sens Paris in India, providing consulting and training to the fragrance industry.

603 Matrix
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+91 794 004 6006 / care@allgoodscents.com
http://www.allgoodscents.com

AromaKnowledge

AromaKnowledge offers consulting services for the fragrance industry, including fragrance oil production and formulation, candle production and merchandising, creative perfumery and fragrance training for skill acquisition and refinement.

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Allendale NJ 07401 United States
+1 201 741 8357 / kari@aromaknowledge.com
http://aromaknowledge.com

Ars Aromatica Studio

ARS Aromatica is an exclusive partner of Cinquième Sens Paris in Mexico, providing a range of services to the fragrance industry including scent design management, consulting, olfactive training.

Fabrica Hercules Ave Hercules Ote 1 - Studio 12
Queretaro Querétaro 76146 Mexico
+52 442 169 6311 / contacto@arsaromaticastudio.com
http://www.arsaromaticastudio.com

Atelier Olfativo

Atelier Olfativo offers a range of services dedicated to spreading the culture of smell, including creative consultation, trend monitoring, marketing, research, concept creation, event planning and perfumery training.

Calle 69 No. 10 – 40 Barrio Quinta Camacho
Bogot¡ Cundinamarca Colombia
+57 320 488 3912 / ana.paez@atelierolfativo.com
http://www.atelierolfativo.com

Cinquieme Sens

Cinquième Sens offers a variety of services from creation and consulting to training and events management for the fragrance industry.

18 Rue De Monttessuy
Paris 75007 France
+33 14 753 7916 / contact@cinquiemesens.com
http://www.cinquiemesens.com

Cinquieme Sens Northern Europe

Cinquième Sens provides an array of educational services including perfumery training, in-company programs and custom-made courses, as well as event management for the fragrance industry.

Keizersgracht 62
Amsterdam 1015CS Netherlands
+31 0 20 5206818 / info@5sne.com
https://5sne.com/en/

Esha Flavor Solutions LLC

Esha Flavor Solutions offers flavorist training in addition to a range of services, including flavor creation, duplication and modulation.

37, Continental Road
Morris Plains NJ 07950 United States
+1 862 242 4314 / flavorchemist@yahoo.com

L'Atrlier Aromatic

L'Atrlier Aromatic is an exclusive partner of Cinquième Sens Paris in Argentina providing perfumery education and creation services.

Robles 17 Abril club de campo
Hudson Buenos Aires 1885 Argentina
+54 9112 648 5380 / ibarrioses@icloud.com
http://www.editoradeperfumes.com

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Via Alceste De Ambris 4
Parma 43122 Italy
+39 052 127 1457 / info@mouillettes-and-co.com
http://www.mouillettes-and-co.com

Paralela Escola Olfativa
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Rua Claudio Soares 72 Conjunto 504
São Paulo 5422030 Brazil
+55 113 853 7576
http://www.paralelaescolaolfativa.com.br

Passion Nez
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12 Rue Jean Ossola 2 Ième Étage
Grasse Provence Alpes Côte D'Azur 06130 France
+33 61 353 3114 / contact@passionnez.com
http://www.passionnez.com

Shiva Perfumatics
Shiva Perfumatics offers a range of services for the fragrance industry including workshops, olfactory training, merchandizing and branding services.

5 Shyamnagar Society L.H. Road
Surat Gujarat 395006 India
+91 940 804 3623 / blenderspalette@gmail.com
http://www.shivaperfumaticss.weebly.com

The Powder Room
The Powder Room is an exclusive partner of Cinquième Sens Paris in Australia and New Zealand specializing in perfume product development and training.

303/37 Swanston Street
Melbourne Victoria 3000 Australia
+61 4 2235 1611 / info@thepowder-room.com
http://thepowder-room.com

As the Inventor of the ductless fume hood, Erlab is an expert in air filtration for the protection of laboratory personnel since 1968. With over 50 years of experience and 150,000 units installed in 40 countries, Erlab offers advanced technology that protects lives, saves money and enhances environmental sustainability. All our products are certified by experts for individual applications, ensuring that our products fully meet customer expectations.

With manufacturing facilities in the US, China and Europe, employing highly trained engineers and scientists worldwide, we deliver solutions globally.

usa.erlab.com/flavor-and-fragrance

Our Milli-Q® Lab Water Solutions portfolio offers a broad range of pure and ultrapure water purification systems and services designed for both validated and non-validated environments. We also offer complete solutions designed to meet your laboratory water needs. Our Lab Water experts will take the time required to evaluate your unique situation and to propose the best-adapted lab water purification solution.

From water purification systems to allergen standards and aroma chemicals, we have what you need to safely meet consumer demand with products you trust.

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www.osmose06.com

Foods, flavors and fragrance industries look to Pope Scientific to address demanding separation, purification applications. Pope offers Wiped Film Evaporators for product concentration; Molecular Stills for high vacuum separation of high BP and MW components; and Hybrid Stills for efficient, more selective fractional column distillation of heat-sensitive compounds. Other offerings include Nutsche Filter-Dryers, Custom Vessel Systems, Reactors and Cannabis Specialties. Pope also offers Toll Distillation Processing Services providing unexcelled GMP/kosher contract outsourcing, process development and feasibility testing resources. Applications encompass Foods, Flavors, Fragrances, Fruit & Vegetable Oils, Wood & other Botanical Extracts, Fermentation-derived Products, Essential Oils, Cosmetics, Pharmaceuticals, Waxes, Cannabinoids and more.

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- FEMA 2846 BLACK PEPPER OLEORESIN
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- FEMA 3106 VANILLA OLEORESIN
- FEMA 4705 ROSEMARY OLEORESIN
- CORIANDER OLEORESIN
- CUMIN OLEORESIN
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